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THE GIANT OF THE SKIES

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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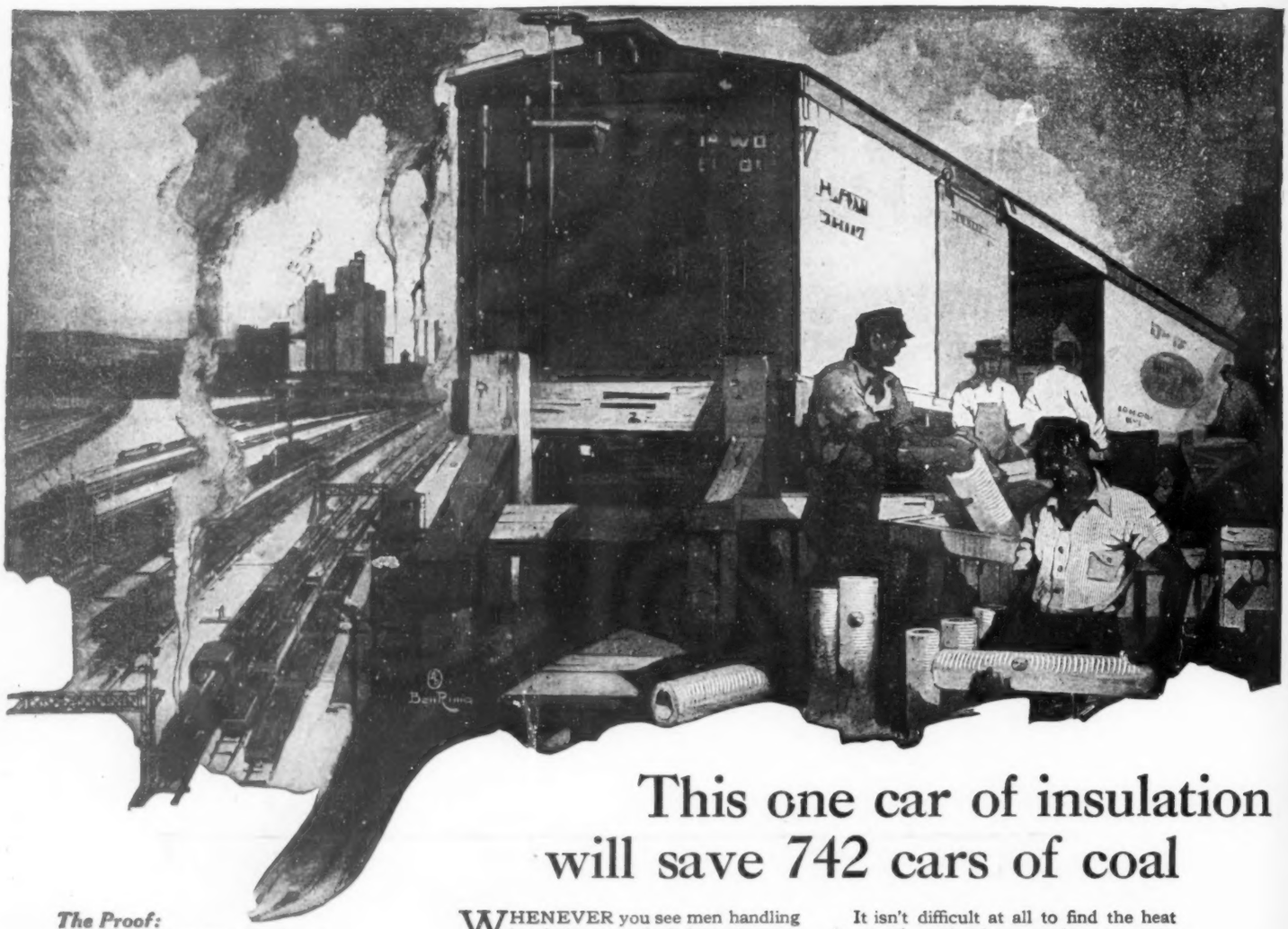

This one car of insulation will save 742 cars of coal

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WHENEVER you see men handling insulation, you don't have to wonder what they are going to do with it—you know that they are going to do the very thing that this country so badly needs: SAVE FUEL—and what is equally important, you can know exactly *how much* fuel they will save—for the hit-or-miss stabs of the old "pipe covering" days have given way to a modern science of insulation by which anyone can predetermine his saving and apply these figures to his costs whether it be for power in the plant or heat in the home.

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It isn't difficult at all to find the heat losses through pipe covering you may have installed in the days when you didn't need to get down to brass tacks in saving fuel. Such figures compared with Johns-Manville charts will point out the difference between what heat you now save and what you can save through the most efficient commercial insulations obtainable — whether it be Johns-Manville 85% Magnesia of the molded type or Asbesto-Sponge of the strong built-up Felted type.

Figures shown at the left give evidence of the millions of dollars saved annually by Johns-Manville Insulation Service in not only determining the insulation that is right for you—but also in applying it for you in the right way.

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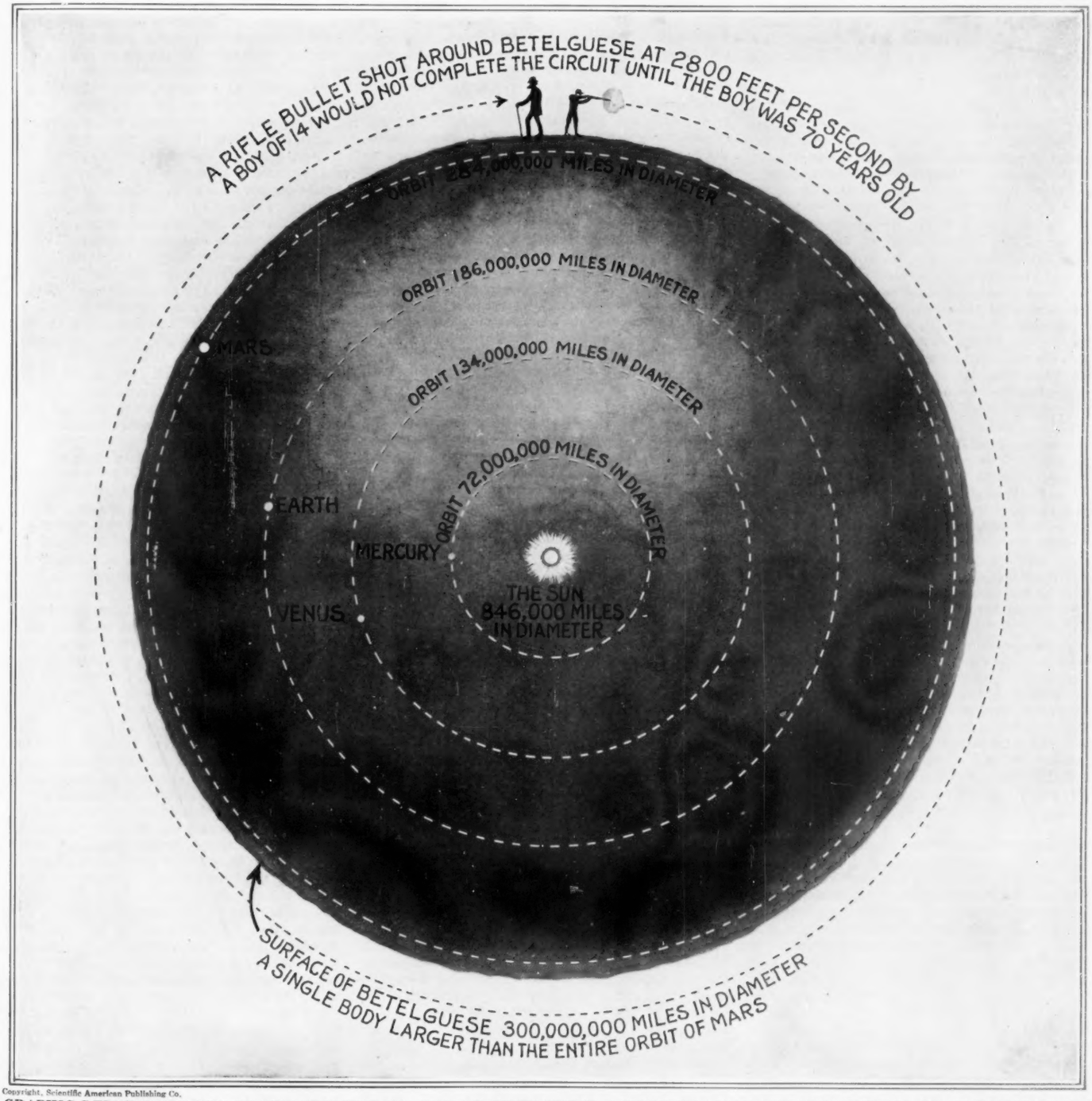

A GRAPHIC REPRESENTATION OF THE TREMENDOUS SIZE OF BETELGUESE, A HUGE SUN LIKE OUR OWN, BUT ALL OF 300 MILLION MILES IN DIAMETER—[See page 409]

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Co-Ordinating Our Waterways

IT cannot be denied that Nature has been lavish in the provision of navigable waterways on the Northern Continent; it is equally certain that no proportionate advantage has been taken of these facilities, not at least during the era of the steam railroad and the motor truck. Prior to the age of railways the people of this country were driven to the use of our navigable rivers and inland waters by the sheer force of necessity. Travel by steamboat was faster and cheaper than travel by the slow stagecoach and the lumbering freight wagon. To a limited extent the national waterways were linked up by canals of small size, and some of these, in spite of their shallow depth, demonstrated their capacity for the opening up of sparsely settled and undeveloped country to such a marked degree, that it is indeed surprising that our canals should have become stagnant and ultimately passed into the limbo of discarded utilities.

The most ambitious and successful among these early canal systems was that undertaking, stupendous for its time, of linking the Great Lakes to the Atlantic Ocean by means of the Erie Canal, or "Clinton's Ditch," as it was doubted by the doubters of that early day. De Witt Clinton, however, had imagination, vision and courage, though in 1825 when, as part of the ceremonies attending the opening of the canal, he sailed down New York Bay to Sandy Hook and emptied a vessel of fresh water brought from Lake Erie into the salt brine of the Atlantic, it is likely that even he, with all his faith, little dreamed of the enormous advantages which the completed canal was going to confer, not only upon the Port of New York, but upon the whole territory traversed by the Canal.

Then came the railroads with their more speedy and cheaper system of transportation, and gradually and inevitably the Canal suffered from neglect. Our forefathers of that day apparently failed to grasp the lesson which had been taught by the Erie Canal; otherwise they would have steadily improved and enlarged their systems, realizing as the engineers on the continent of Europe have done, that a network of canals is the natural complement to a system of railways.

Today we have in the rebuilt and enlarged State Barge Canal a system which is capable of moving twenty million tons of freight during the navigation season. It forms a natural outlet for a considerable share of the great amount of freight traffic from the Middlewestern States, which is carried by rail to the ports of the Great Lakes and by water to the western terminals at Buffalo. Of grain alone, from 50 million to 100 million bushels are received in Buffalo each year for export shipment, and of that amount, six million bushels only were moved through the Barge Canal in any one year of its prosperity.

Much has to be done before the Canal can fulfil its purpose as a link between lake and ocean traffic. The present is the psychological moment for developing waterway traffic to its fullest capacity; for the high cost of transportation by the railroads and the heavy congestion are factors which should prove to be very helpful in diverting its legitimate share of freight transportation to the Canal. A movement is now afoot under the auspices of the Middlewest, Great Lakes, Hudson River and Atlantic Association, to develop the necessary terminal facilities at Great Lake and Atlantic ports, and to secure the coöperation of the operators of ocean-going vessels with inland waterway interests represented by the State Barge Canal and the Great Lakes shipping interests, so as to stimulate a through bill of lading movement. If this can be brought about, a manufacturer located on the Great Lakes, on the State Barge Canal, or indeed, on any inland waterway, will be able to ship his goods by means of an all-water route with a through bill of lading to a foreign port. This is a most practical movement, which should command the support not merely of the shipping and canal interests themselves, but of every commercial body throughout the territory that is served.

The "Mystery Towers" Explained

WITH the passage of time the greater secrets of the war are gradually being disclosed, a case in point being those enormous concrete structures which were built on the English side of the Channel for a purpose which was most carefully concealed as long as the war lasted, and indeed, was known to a very few for a long period after the Armistice. A description of the launching of one of these was given in the SCIENTIFIC AMERICAN of October 16, 1920. It will be remembered that the towers were built on the foreshore and were launched in the regulation fashion at high tide. They were circular in plan, with a maximum diameter at the base of about 200 feet, and they were some 250 feet in height. The whole thing constituted a huge, hollow, monolithic mass of great weight and strength.

Speculation naturally was rife as to their purpose, and in this respect they shared attention with the so-called "Hush-Hush" ships themselves. Generally and popularly they were supposed to be intended as forts which were to be floated to position and sunk until they rested upon the sea bottom, leaving a sufficient portion of the upper structure exposed to serve for the mounting of heavy ordnance. Now, however, it appears that these two were only a pair out of some score of similar towers which were to be built, and that their purpose was to assist in absolutely closing the English Channel at Dover against the passage of submarines. They were to be floated out and sunk at intervals of a mile, and serve as anchorages for very heavy chain nets which were to be stretched from tower to tower. Their heights would have varied according to the depth of the water, and the tops of the towers being clear of the waves, were to be used as emplacements for batteries of guns.

Things were done on a big scale during the war, and certainly this scheme for absolutely shutting up the Channel was one of the most ambitious. It would have cost a pretty penny by the time it was completed; but considering the great strategical advantage of forcing submarines to pass out and return to the North Sea around the north coast of Scotland, the venture would have been well worth its great cost.

Our Railway Mileage Is Shrinking

IF anyone had dared to predict in 1912 or at any time in the preceding seventy-five years, when our railroads were weaving their net over the land, that a day would come when that development would cease and a positive shrinkage in the totals would appear, he would have been laughed out of court. Yet, once more it is the unexpected that has happened, and statistics compiled by the *Railway Age* show us that railway construction has been reduced practically to nothing and that the very slight addition of 314 miles in 1920 has been more than wiped out by the fact that 713 miles of line were abandoned and that on 240 miles of this the track was actually taken up. This gives a net loss in 1920 on the whole railway system of about 400 miles. Going back to twenty-five years ago, we find that in 1895 there was built 1,420 miles of new line, and that the yearly record rose until it reached 6,026 miles in 1902, an increase which probably will never be surpassed in the future. From 1902 there was a decline until the annual total reached about 3,000 miles, which continued for the years 1911 to 1913. The influence of the war was quickly manifest in slowing down new construction, and in 1914 there was a drop to 1,532 miles of new line, and in 1915 to 932 miles, with a rise to 1,098 in 1916. From that time there was a steady decline to 686 miles in 1919.

Because of the fact that the existing railroad system is badly in need of reconstruction—some of our ablest experts have stated that it will take five billion dollars to bring the roads up to perfect condition—it will probably be several years before any marked activity in the building of new roads takes place. On the other hand, it is certain that when conditions have come back to normal, there will be ushered in gradually a new era of road building to meet the inevitable expansion in population and industry. This construction will be confined to developing the existing roads by the building of interconnecting lines and feeders to the trunk lines.

Words of Wisdom on the Shipping Problem

THERE is probably no subject, unless it be that of Reparations, upon which so much has been said and written and such diverse solutions offered as in respect to the problem of our Shipping Board policy. To our thinking, the best summing up of the situation is that which was made by James A. Farrell at the recent National Foreign Trade Council Convention in Cleveland, Ohio.

Looking at the matter broadly, Mr. Farrell laid his finger at once on one root of the trouble when he said that the present conditions are the outcome of haphazard efforts to deal with a problem which from the very first called for a settled policy and a well-defined purpose. To begin with, for a period extending from the Armistice well into the year 1919, there was an opportunity to dispose of a large portion of the fleet at prices bearing a fair relation to a moderately depreciated cost. That was the time, our readers will remember, when a *bona fide* offer was made to purchase the "Leviathan," a deal which would have gone through except for the spiteful opposition of the Hearst papers and certain other influences of a strongly anti-European flavor. Through not taking advantage of this opportunity, the Government, says Mr. Farrell, "missed its market," and, it is estimated, lost a chance to realize at least 800 million dollars, this sum representing the difference in the market value of the tonnage which could have been sold at that time and the value of the same ships today. The Shipping Board fleet cost over three billion dollars, and the question of getting rid of these ships by sale is hampered by our perfectly impossible navigation laws. We are told, moreover, that even a temporary improvement in ocean freights would fail to absorb the world's idle tonnage in less than three years. Approximately seven million tons of the world's carrying capacity is laid up out of a total of 60 million tons, of which five million tons is not yet completed.

In Mr. Farrell's opinion, we have to recognize that the policy of the Shipping Board of endeavoring to build up trade routes from every Atlantic, Gulf and Pacific port to practically every port in the world is expensive, and, under present conditions, impracticable. He believes that a partial solution of Shipping Board difficulties would be to lay up a considerable portion of its tonnage and withdraw from all but supervisory activity by chartering the steamers to reputable and experienced operators. With this policy we have always been in hearty agreement. The operation of shipping, with all its multiplied and varied activities and problems, is one of the most highly specialized branches of commerce and industry. It should be left to the genius of the men who have had long experience. The Shipping Board scheme of laying out trade routes and supporting the unprofitable lines by active and very generous financial help is attractive on paper, but, as the event has proved impossible of fulfilment, at least under the present disturbed world conditions.

But after all is said and done, Mr. Farrell lays his hand upon the most serious handicap of all when he says that the main factor in determining whether we can compete successfully with foreign tonnage is our shipping laws. From the very day on which the La Follette bill was passed the SCIENTIFIC AMERICAN has realized that this bill would be the undoing of our Merchant Marine; and everything that has happened since then has proved the fear to be well founded. Not only do our navigation laws strangle our ocean-going ships, but they are affecting even the carriers on the Great Lakes, where we have no local foreign competition. As compared with competing foreign ships on the high seas, American vessels must maintain larger crews, 65 per cent of whom must be licensed men and they must carry in the engine room crew 30 per cent more men. The solution of the shipping problem lies in chartering the boats to competent people of long experience in the shipping business, coupled with a drastic revision of our navigation laws.

Automobile

Water Pressure Damages Body. — When washing the car, don't turn the hose directly on the wheels or body unless the water pressure is very low. Pressure usually built up by the nozzle is sufficient to mar the paint or dislodge it where the water is foolishly dashed against the surface. The best way is to use a pail of water and a sponge. Then much gentler treatment of the paint will result. After this mud is loosened with the sponge and water, it may be flushed off with the water from the hose, which is used without the nozzle.

The Engine as a Brake.—Some motorists appear to have the mistaken notion that it is harmful to the engine to use the compression as a brake in going down steep hills. Shut off the engine and leave the gears in mesh, so that the wheels drive the engine against the compression in the cylinders. Be sure that the throttle is closed. This will help to save the service and emergency brakes from excessive wear. If greater braking power than that afforded by the high speed position of the gears is needed, shift into second or low, the braking effect being increased as you step down because the rear wheels drive the engine faster.

Palm Oil as Fuel.—A series of experiments, begun in 1914, but interrupted by the war, has recently been resumed in Brussels on the use of palm oil in internal-combustion motors. A Swedish two-cycle semi-Diesel engine was found which would run successfully on palm oil. According to analysis by Belgian chemists, palm oil is a mixture of palmitate and oleate of glycerine, with some variable quantities of palmitic and oleic acid. It contains about 95 per cent of fatty acids and appears as a pasty substance of yellowish or salmon color. Its caloric power is estimated at 9,228 calories (Barthelot-Mahler), and it is inflammable at 210 degrees centigrade.

Average Life of Automobile.—As highway transportation develops and passenger cars and trucks become practically the sole means of road travel the proportion of first purchasers of cars and trucks in the total of car sales will decrease, and the demand for new cars each year will become more and more nearly equal to the number of cars which drop out of service. For this reason it is becoming increasingly important for the trade to know how many cars will be required for replacement of those withdrawn from service. Analysis of registration, production, export and import figures over a period of years leads to the conclusion that the average life of the 2,000,000 cars retired from service in the last 7 years was about 5.3 years.

Use of Aluminum in Auto Manufacture.—An average of 120 pounds of aluminum is used in the manufacture of all automobiles—Fords excluded—according to a brief filed by the National Automobile Chamber of Commerce with the Ways and Means Committee of the House of Representatives. This figure was obtained from the principal aluminum producer, and it refers to the allotment of the crude aluminum set apart for the automotive industry by this company. In some cars the weight of aluminum used is as high as 250 pounds. The automotive use of aluminum is estimated at 120,000,000 pounds, 60 per cent of the production. The brief was filed as supporting the request that the present duty on aluminum of two cents a pound should not be increased. One of the present obstacles to the use of aluminum in our industry is the price and if the tariff is removed the demand for the metal would increase.

Tractors Have Winch Attachment. — Caterpillar type tractors are extensively used in the logging industry as well as in the oil fields. The winch attachment recently developed facilitates skidding logs out of relatively inaccessible places, and is useful in pulling and running back tubing and rods used in oil wells. The winch is operated independently of the driving mechanism of the tractor. The drive is from the rear of the transmission-case by propeller-shaft and gear-train to internal gear planetary and final bevel gears. A clutch of ample size to permit slipping indefinitely is provided. The standard pulling speed of the 5-ton winch is 108 and 252 feet per minute on low and high gear respectively, and the corresponding pulls are 10,400 and 4,450 pounds. Maximum reverse speed is 583 feet on low and 1,360 feet on high gear. Other speeds are obtained by slipping the clutch. Two other sets of gear ratios are provided at option. The winding drum is 8 inches in diameter and 13 inches between flanges, and has a capacity of 1,300 feet of ½ inch, 850 feet of ⅝ inch, or 590 feet of ¾ inch cable. All shafts and gears are nickel or carbon steel, the gears being case hardened. Ball or roller bearings are used throughout and the gears and moving parts are enclosed.

Science

Compressed Wheat.—An odd suggestion comes from England as to conserving wheat. It is proposed to crush or rough grind wheat, then soften with superheated steam and compress in hard blocks and store until wanted, when a simple crushing process would fit it for flour manufacture.

A New German Clock that records all kinds of things besides time aroused the interest of Consul Breed at Prague to such an extent that he wrote the Commerce Department all about it. He saw it at a fair and said it would tell the second of the minute, minute of the hour, hour of the day, day of the week, week of the month, month of the year, season of the year, position of the stars and the exact position of the earth in its orbit, all for the trifling cost of 5,000 Austrian crowns, or about $50 in real money.

Lead-Lined Gloves Minimize the Danger of Radium. —Experienced scientists who experiment with radium are using lead-lined gloves, but younger operators are apt to neglect such safety devices. Wooden tables should also be provided with lead linings to save the legs of the experimenters. The rest of the body can be protected by thin metallic sheets. The dangers with radium are so great that the French Academy of Medicine has granted a special subvention looking toward the amelioration of the dangerous conditions.

The American Museum of Natural History is in need of money. President Osborn in his last annual report calls attention to the necessity of nine new additions to cost $10,000,000. It is now fifteen years since the last building addition was made and since that time the collections have grown enormously. The following are the nine new buildings proposed: Asiatic Hall, Oceanic Hall, School Service Building, Roosevelt African Hall, Roosevelt Memorial Hall, Astronomic Hall, Aztec Hall, South American Hall and an auditorium and lecture hall seating 3,000.

Woman Mummy Found in Denmark.—The mummified body of a woman who died 3,000 years ago was found recently buried in a field in the Jutland district of Denmark and is being unwrapped by employees of the National Museum. Her coffin was the hollow trunk of an oak tree and the body was wrapped in a cowhide, says a cablegram to the *New York Herald*. She appears to have been a person of rank. Her garments included a short jacket with sleeves and a petticoat and she wore two belts around her waist and two bronze bracelets on her arms.

The Curie Family Continues to Make Discoveries.— The luster of the Curie family continues undimmed. Mme. Curie has succeeded in determining the respective proportions of radium and mesothorium, which has hitherto baffled the savants who have considered mesothorium as more powerful. Professor Laporte, a cousin of Mme. Curie, has discovered a new method for measuring the speed of gaseous emanations. Mlle. Curie, a niece of Mme. Curie, after months of study, has succeeded in determining the atomic weight of some substance the name of which is garbled in cable transmission.

Again the Half Nickel.—A two and one-half cent coin is not a new proposition. It was proposed during the war to help reduce the cost of living. Another minor coin is not considered desirable by all. Some persons are afraid that 5 cents would go up to 5½ cents if a convenient coin were provided, but many commodities would undoubtedly be decreased thus "two for a quarter" could safely be 12½ cents for one. Daily papers which are now three cents would in many cases be reduced to 2½ cents. One of the tangible objections would be the fact that cash registers cannot cope with the extra half cent at present. The idea of the coin's bearing a likeness of Theodore Roosevelt is a good one. Zinc has been urged as a metal for the new piece.

Treasure Trove in the Goodwin Sands.—The idea of searching the Goodwin Sands for treasure is not quite a novelty. Several proposals have been made before to recover the millions mentioned by Lord Headley in his presidential speech to the Society of Engineers. The chief and most promising of them came from two men—a civil engineer named Bush and J. D. Pain, an architect. They proposed to construct a harbor of refuge out of Trinity Bay, and from it to tunnel the sands, says the *English Mechanic*. The work was to take many years. The idea caught on, money was promised, but more practical men pronounced against it. Another suggestion was to run out a master tunnel from Deal and from it to have short tunnels branch off. A third scheme was that of a Midland mining engineer, who became so obsessed with his idea that at last he went mad and drowned himself on the very sands he proposed to explore.

Industrial Efficiency

Permanent Vienna Fair.—Plans are well advanced for the establishment in September, 1921, of a permanent industrial fair in Vienna. A company has been organized for the purpose. It is proposed to exhibit at the permanent fair manufactured goods of all kinds and from every country. It is hoped that this exhibition will furnish an opportunity for buyers from the eastern countries and the Balkans to meet representatives of western manufacturers and to inspect their products, thus facilitating trade between the east and west through the old established channels in Vienna.

A New Source of Tannin, it is learned from Consul Starrett, has been obtained by a resident of Adelaide, Australia, who has secured from the Government of the Fiji Islands the rights of all the Donga timber in that colony, and a small company is now being formed. This is undoubtedly a most important development, as the Donga tree carries a thick bark which contains a very high percentage of tannin. The wood is also exceedingly hard and durable. The percentage of non-tannin in the liquid produced from the bark is so small that it easily outrivals the Australian and South African wattle bark, which hitherto has always held the leading position as a source of tannin extract.

Britain's Efforts to Increase Foreign Trade.—It is reported that the Department of Overseas Trade is "steadily extending its trade-commission service in all of the principal markets, and is keeping traders well advised of German methods and of trade openings available for British exporters." Large numbers of merchants and traders will visit the Leipzig fair. British wholesale prices are being drastically cut and the fact is made widely known by a new scheme of mass advertising in all the world's leading newspapers, in Australia, France, Japan, India, South America, South Africa, Belgium, Holland, Cuba, Scandinavia, and so on. In some cases the advertisements will run parallel with German manufacturers' announcements so that a comparison of prices and of quality can be studied by foreign buyers.

Unemployment Insurance.—The British unemployment insurance act of 1921, which became effective on March 3rd, increases the weekly rate of unemployment benefit to 20s. per week for men and 16s. per week for women, with half rates for boys and girls. From July 4th, 1921, increased weekly contributions will become payable, viz., 11d. for men (6d. from the employer and 5d. from the worker), and 9d. for the women (5d. from the employer and 4d. from the worker), and corresponding half rates for boys and girls. During each of the periods, March 3rd, 1921, to November 2nd, 1921, and November 3rd, 1921, to July 3rd, 1922, a maximum of 26 weeks' benefit may be drawn in each insurance year. It is interesting to note that any applicant losing his employment through misconduct, or owing to a trade dispute, or leaving it voluntarily without just cause, will be disqualified for benefit.

Pilferage in Transit.—The current *Journal* of the Huddersfield (England) Chamber of Commerce contains an article on pilferage and packing, in which attention is drawn to the systematic thieving in connection with goods in transit, and the question is raised as to what extent packers are responsible. "It is safe to say that if all goods, at all times, were as much at the mercy of thieves as are 'goods in transit' the business world would have to put up its shutters, because it could not carry on." While losses are directly due to thieves, it is suggested that it is nevertheless a fact that very often "the sight of means to do ill deeds makes ill deeds done," and one fault of present-day shipping practice is that it affords many opportunities to "make a thief." The object of packing, we are again reminded, is not merely for the protection against damage, but for security against theft.

Harnessing Small and Medium Height Waterfalls.— A new and quite simple type of turbine has been introduced in Germany. It works with any quantity of water from 26 to 1,300 gallons per minute and a varying head of from 6 to 300 feet. The new machine is an adaptation of the Poncelet waterwheel; the water first passes through buckets to the interior of the wheel exhausting a large portion of its power, and then enters the driving wheel a second time from the inside through a covered guide wheel and parts with the remainder of its energy. The net result is a compound action which gives a useful effect of rather more than 80 per cent, continues *The Technical Review*. The turbine shaft is placed horizontally and the water may enter through a pipe thus enabling the turbine to be coupled direct to a generator, or, if desired, it can be placed in an open pit. It rotates at a high speed which is easily regulated while running by an adjustable governor.

Putting Waste Metals to Work

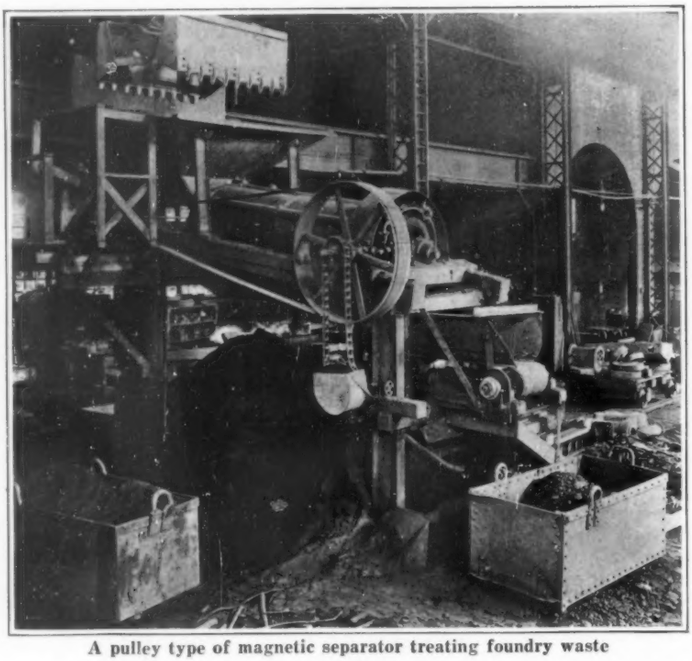
Methods and Machines That Make It Profitable for Every Plant to Handle Its Own Junk

By Robert G. Skerrett

THE salvaging of our metallurgical derelicts has become a business of imposing proportions, and the more we persist in this form of conservation the better able shall we be to hold our own in the near future in that keen industrial competition which is bound to tax productive cunning to the utmost.

The old bit of lead pipe, the odds and ends of cast-off iron, the battered door knob, the leaky faucet, the tinsmith's waste, the copper kettle that has served its day, and thousands of other articles of allied sorts have long been classed in the popular mind as junk. To the man in the street they have fulfilled their primary purpose and are fit only for the scrap pile. It is well, however, that there are others among us who do not look so indifferently upon these waste materials. In the language of our Government experts such scrap is today dignified as "secondary metals"; and their value in the course of a single year reaches a total of tens of millions of dollars.

The war we waged upon waste during the recent period of strife brought home to us how spendthrift we were ordinarily; and practices were then instituted which can be of incalculable good if we persist in them nationally henceforth. From now on the aim of our factories and mills must be to realize quantity output with a stricter regard to the costs involved. The problem is not going to be one of promptness of delivery so much as profit at an attractive price. We have got to count the pennies and put to service metals, for instance, that formerly were thrown aside with little heed to their possible re-employment. Indeed, in some fields, we may be called upon to reuse a given quantity of metal several times in the course of a comparatively brief interval. And what have we already done in this direction?



A pulley type of magnetic separator treating foundry waste

In 1915 the value of the secondary recoveries from six metals amounted to more than $114,000,000, and the U. S. Geological Survey reports that secondary copper, brass, lead, zinc, tin, antimony, aluminum, and nickel reclaimed two years ago represented $181,841,500. And what about iron and steel scrap and the various ferro-alloys that were remelted during 1919? It is estimated that this particular group of secondary metals bulked substantially 8,000,000 tons and that they ranged in value from seven dollars to several hundred dollars a ton. This happened in a year when our railways were yielding only about 60 per cent of their normal supply of old iron and steel.

Ordinarily, the average yearly discard of iron and steel by our land lines totals about 8,000,000 tons, and at a conservative figure this material should bring not less than $100,000,000. This seeming wastage is not hard to understand when we recall how extensively iron and steel figures in the equipment of the rolling stock and the roadbeds of these great and far-reaching common carriers. So much for the baser metals; and now for some of those of the rarer short that are made fit again for service.

The secondary platinum, iridium, and palladium recovered from domestic sources in 1919 was worth $8,053,265, and was more than the value of the platinum and allied metals which we imported for consumption during the same twelvemonth. It may never have occurred to you that when you parted with a filled tooth you were perhaps contributing to a veritable bonanza, but it seems that dental waste and jewelry furnish the largest share of secondary gold, while silverware and photographic waste yield us most of our secondary silver. According to the Government authorities, the gold or silver contained in old jewelry, dental waste, silver tableware, ornaments, and other articles remelted two years back was in excess of $27,592,-060. Mints and refineries reported the recovery of 6,463,002 fine ounces of silver and $19,354,398 in gold from refuse or discarded material.

In the course of a twelvemonth one small refinery reclaimed 30,000 ounces of silver from the waste of some moving picture laboratories. Those familiar with the business are aware that a considerable part of well-nigh every new film is spoiled or cut out before the reel is displayed, and, besides, old films are scrapped. All films contain silver in their coatings, and so do the solutions in which films are originally developed. It pays to adopt measures to salvage this precious metal.

As many of us know, the lead-in wires of electric light bulbs are commonly made of platinum because the coefficient of expansion of that metal is so low that it will stand wide variations of temperature without tending to crack the enveloping glass. In the past little was done to recover the imbedded filaments in cast-off globes; but an example was set in the direction of conservation during the war at the house of correction of a large Western city. A testing plant was created for the examination of discarded light bulbs found in the municipal waste. Not only was a sufficient number of good lights thus discovered to meet the needs of the entire institution, but platinum that sold for more than $9,000 was reclaimed from the "dead" lamps.

Not long ago the repair-shop foundry of one of our big trunk lines devoted half of its time to the manufacture of new bearings for its rolling stock, but by improved practices this work was reduced nearly 40 per cent. The bearings proper are of bronze and lined with an anti-frictional composition. The remedy adopted was to melt out what was left of this soft metal lining whenever the bronze bodies came into the shop and to recast the lining material into ingots. From these ingots, when remelted, bearings, otherwise sound, were refilled. The system developed for recovering the old lining metal became so complete that only 25 per cent of new anti-frictional metal had to be bought to take care of this particular department of the road's requirements. A quantitative idea of the savings thus made possible can be gathered from the fact that in 1917 a single large railway purchased and worked up

Left: Briquets of flue-dust being carried by a belt conveyor from a briqueting machine to the blast furnace. *Above:* Partly consumed flue-dust briquets, showing how these hold together while undergoing melting in the furnace. *Right:* Machine for the briqueting of borings, turnings and millings from machine-shop waste. The finished blocks are discharged from the elliptical opening at the lower left of the view

How scrap is compressed into large cakes where it could not profitably be handled loose

21,000,000 pounds of bearing metals to carry the loads superposed upon the journals of the line's myriad car and locomotive wheels.

In machinery of all sorts brass and bronze figure extensively, and these metals, when scrapped, are not infrequently associated or mixed with iron and steel. This is especially true in machine shops where the turnings from lathes, etc., dealing with various materials, are swept up together and dumped in common piles. Miscellaneous scrap of this character is of little or no value as it stands, because there should be no iron or steel in brass castings and no brass in ferrous ingots or castings. It is therefore highly desirable that the ferrous and the non-ferrous metals be segregated so that they may be made ready for remelting. This could not be done cheaply and rapidly on a commercial scale but for the evolution of magnetic separators, which are obtaining steadily increasing recognition in our industrial life.

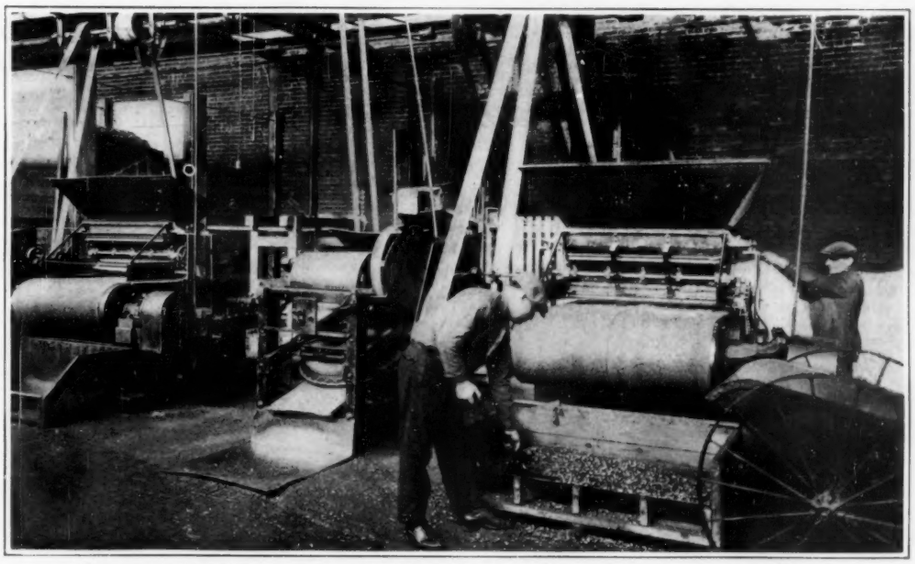
It has been said that a handful of iron will ruin a hundred pounds of babbitt metal; and iron in brass and copper alloys is likely to occasion grave trouble in working up the castings. This is owing to the manner in which iron forms into small nodules which absorb all of the carbon in the surrounding non-ferrous mass and become harder even than the hardest of tool steel. If, for example, the cutting tool strike any of these while machining a brass casting the instrument is apt to break, and, apart from the money loss in the damaged tool, the latter may injure the casting before the operator is aware of it. Plainly, much is to be gained by separating the antagonistic metals.

Where borings and turnings are very oily it is needful to remove this coating before separation begins, inasmuch as the oil causes fine iron particles to stick to the other metals and thus to draw the latter along with the iron. This objectionable oil can be got rid of by various means. In general, in handling mixed metals, it is advisable to screen the chips through a half-inch mesh before feeding them to the separator. For the treatment of a combination of iron, steel, brass, copper, aluminum, or nickel scrap of this character, what is known as the disk-type of separator answers admirably.

In a machine of this sort the magnets consist of a large, stationary, primary magnet body and a series of small, secondary induced magnets which are mounted upon a rotating disk. The primary magnet has heavy double coils and cores with pole pieces projecting downward and conforming to the circle of the disk. The secondary magnets, made of Swedish iron, are inductively energized by the primary magnet, but become demagnetized as they sweep beyond the neighborhood of the primary poles and when so weakened they drop any iron or magnetic material that they may have attracted. In this way the discharge falls into a conveyor and is transported to a near-by box or bin, while the non-magnetic substances are carried to another point of deposit.

For handling bulkier materials there has been devised a pulley-type of magnetic separator. In apparatus of this kind the magnetism is strong enough to exert itself at a given point through the conveyor belt that turns about it. In operation, as the mixture comes within the magnetic zone of the pulley, the magnetic bodies are attracted and carried around and beneath the magnet where they are released and free to fall into a receptacle,

(*Continued on page 415*)



Two magnetic-pulley separators, on either side of a disk separator, also of magnetic type

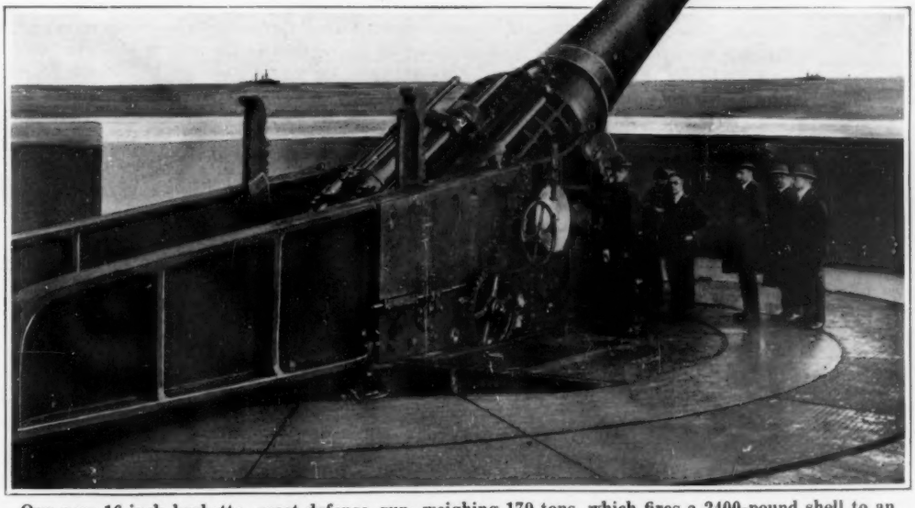
Our New Sixteen-Inch Barbette Coast-Defense Gun

IN our issue of January 29th of this year we described and illustrated the new 16-inch, 170-ton, disappearing, coast-defense gun, a type which is to be mounted in some of our most important fortifications. We now present a photograph of the same gun on the new barbette mount, which has been designed by Army Ordnance and built at the Watertown Arsenal. The mounting shown in this photograph is the first of its type to be built.

The disappearing mount, it will be remembered, was designed to permit the loading and sighting of the gun to be done below the shelter of a massive sand-and-concrete parapet, with a view to giving protection to the gun and its mounting and the crew. After the gun is loaded, it is raised by its counterweight until the barrel is clear of the parapet, and on firing, the energy of recoil carries the gun back and down once more into the loading position. The barbette mount is simpler, inasmuch as the barrel of the gun is permanently exposed above the parapet. The mounting consists essentially of a carriage and a sleeve, the carriage rotating horizontally on a turntable and the sleeve rotating vertically on journals which form part of the carriage. The gun recoils within the sleeve, which carries the recoil cylinders for gradually absorbing the momentum and returning the gun again to the firing position.

The Army coast defense gun is a huge piece, 69 feet in length and weighing 170 tons. Its heaviest armor piercing projectile weighs 2,400 pounds and has a range of over 22 miles. The powder charge weighs 850 pounds, and the projectile has sufficient energy to penetrate any armor that can be carried by a modern battleship; and it can effect this penetration at any range.

The recent firing tests against the old battleship "Massachusetts," carried out by our Coast Defense Artillery, demonstrated the great effectiveness of high-angle fire; and this mount has been designed so that the gun can be fired at an elevation of 65 degrees. A 2,400-pound shell fired at such an elevation, and falling, as it would, almost vertically from a height of several miles, upon the deck of a ship would unquestionably penetrate to the vitals, even were she a 43,000-ton vessel with the great protective armor of our new "Indiana" class. It is a pretty safe guess that the effect of such a shot would be to cause the ship to fall out of line.



Our new 16-inch barbette, coast-defense gun, weighing 170 tons, which fires a 2400-pound shell to an extreme range of 22 miles

Tin Cans as Fuel

IT might be left to the expert metallurgist to say whether or not there is any material quantity of heat evolved in the burning of tin cans and if so just what their "fuel value" is. As an efficient and sanitary means for disposing of them there can be no question regarding their cremation.

That almost any quantity of tin cans can be conveniently disposed of by burning in an ordinary hot air or steam house-heating furnace cannot be generally known to householders at large or there would be less back yards, vacant lots and dumps cluttered up with this most unsightly and insanitary kind of refuse. As usually thrown out without the formality of rinsing, they are "smelly" and where they not infrequently lodge, they collect rain-water and become most luxuriant breeding places for flies and mosquitoes. All this could be readily avoided by simply "firing" the cans into the furnace along with the other fuel. The burning of a tin can, as any other combustible, is a process of *oxidation*. Oxidation takes place slowly in the space above the fuel bed, because then if the fire is intelligently handled and there is a minimum of "air dilution" there will be no great amount of free oxygen. As the cans are allowed to sink deeper and deeper into the fuel bed, and, finally, into the underlying bed of ashes, they encounter more and more free oxygen which, at a comparatively high temperature, soon results in their almost complete disappearance.

In order that they may be got rid of as quickly as possible it is best to put them into the furnace before firing on fresh coal. They should not be "poked" (neither should burning coal for that matter, except in very rare incidents), but left alone to sink gradually down to, and finally through, the grates, in which there will be nothing left of them but a few scattered fragments of brittle oxide. It may be remarked that practically all other refuse from the house can be disposed of in the same way.

To the city dweller this information may be of minor interest although it does not require a very vivid imagination or otherwise active mind to show what an improvement there would be in the outskirts of every city infested with "dumps" if all combustible matter were disposed of in this way. The refuse from the usual dwelling house would be one product, and one product only—a mixture of fine ashes and clinkers, the former of which in the case of the rural and suburban owner can be readily separated out by dumping on an inclined screen for use in lightening the soil of the garden, and the latter, constituting about 50 per cent by volume, can be disposed of in the usual way or used in making concrete.

The Fragrant Weed

Some Interesting Details in the Art of Tobacco Culture as Practiced in This Country

By William Henry

IT is believed that there are over fifty different species of the tobacco plant, nearly all of which are natives of the American Continent. Only a few of these varieties, however, are cultivated for use in the tobacco industry.

One variety at least (*Nicotiana Affinis*) is used quite extensively as a decorative plant for horticultural purposes, not only on account of its beautiful, white, star-shaped flower, but also for the exquisite perfume emitted toward evening as the dew begins to fall.

Tobacco may be grown successfully all the way from Canada in the north to Chili in the south, and on a great many kinds of soils; but the soil has so marked an effect on the quality of the leaf that different localities become famous for the excellence of the product raised there.

For the general manufacturing and export trade, a variety called White Burley is extensively grown, principally in the blue grass region of Kentucky, southern Ohio, West Virginia and southeastern Indiana. This variety is light colored and possesses capacity for absorbing the flavoring materials used in making the plug tobacco.

The seed of the tobacco plant is very small, and when sown in the cold frames it is usually mixed with wood ashes or land plaster to show how evenly distributed the seed has been. From the middle of March to the middle of April is the best time to sow the beds in the Connecticut district, and the frames are covered with cheesecloth or glass.

When the plants are about 6 inches high they are ready to transplant, usually from the middle of May to the beginning of June. The fields must be well prepared and heavily fertilized or manured.

The plants are set about 17 inches apart, in rows from 3 ft. 3 in. to 3 ft. 6 in. In large areas a transplanting machine is used to plant the fields.

From now on frequent cultivation and hoeing must be done until the plants are large enough to cover the ground. The tops and suckers are then broken off so as to allow the better development of the leaves.

Harvesting the crop begins when the leaves assume a light shade of green, with light tinted flecks, indicating the ripening of the leaf.

There are two methods of harvesting the crop—one in which the bottom leaves are picked by hand as they ripen, and arranged on sticks or strings to hang in the curing shed. The other method (and which is more generally used) is to cut the plants near the root and leave them in rows to wilt in the sun, so that the plant will not break in handling.

The next process is to "spear" the plants; that is, spit a half dozen plants on a lath about 4 feet long, using a removable metal spear-head on the end of the lath, sliding each stalk along. The laths with the plants are now loaded on a wagon and carted to the large barns, where they are hung in tiers about 12 inches apart and at least 3 feet above the ground. These barns have the sides with alternate boards hinged so as to allow free passage of air and proper ventilation.

The curing of tobacco is one of the most important operations, as the color and quality depend a great deal on the way in which it is cured.

From five to eight weeks are required to complete the cure, as much depends on the state of the weather. Artificial heat is used during cold or wet weather, charcoal fires on the floors of the barns being used, with but little ventilation.

After curing, the plants are then taken down and the leaves stripped from the stalks. This is best done in damp weather, as the leaves are then pliable. The leaves are now placed in neat bundles, which weigh from 50 to 100 pounds and are ready for the market.

As the leaves must undergo another process called sweating or fermentation before being manufactured, they are now, as a rule, handled by the packers, who make a business of the fermentation with their especially equipped plants. This part of the process is quite important as they have to control the humidity, ventilation and temperature. This operation continues from one to two years before the cigars are made.

An idea of the immensity of the tobacco industry in the United States may be formed from the size of the internal revenue tax collected by the government.

In the year 1863 the tax was $3,097,620, and for the year 1919 it had grown to $204,982,560.

North Carolina leads all the other states in the amount of taxes collected, being followed in the order named by New York, Virginia, Pennsylvania, Missouri, Ohio and New Jersey, which are the principal tobacco-growing regions.

1. After cutting, the tobacco is allowed to lie in the sunshine to wilt. 2. Spearing the tobacco; four plants are impaled on a stick to facilitate handling. 3. Using an axe to cut the tobacco plant. 4. The sticks with their impaled plants are loaded on a wagon for transfer to the barns. 5. The immense drying barns have every alternate board hinged, to provide for the free passage of air

Getting our domestic tobacco from the fields of Connecticut to the factory

In Cuba the very finest tobacco is grown in the Vuelta Abajo region. The Connecticut valley has also long been famous for the quality of the tobacco raised there.

In the Connecticut valley, however, hailstorms very often ruin a great part of the crops, and nothing will damage a tobacco field so quickly as a hailstorm. Scientists have not yet been able to explain why the Connecticut valley should be visited by these violent hailstorms. Last year (1920) quite large areas of tobacco fields were destroyed, as the hail cut the leaves to pieces, rendering the crop useless.

The soil in the Connecticut regions is suitable for the fine quality of leaf used in the making of wrappers and binders for cigars, this soil being a sandy loam. The leaves for fillers or inside of the cigars are mostly grown in Pennsylvania, the Miami valley of Ohio, in the Onondaga district of New York and in some regions in Georgia and Florida, the soils required for these purposes being much heavier than that needed for the binder and wrapper of the cigar, but the product does not command such high prices.

Britain's First Commercial Airship

THE first British-built airship adapted to commercial service is the "R-36," her civil registration mark being G.F.A.A.F. She was designed by the Admiralty more than three years ago for naval duties and is a progressive development on earlier types of airships, although she does not embody the marked improvements in design which have been inaugurated during the past year. The "R-36" is the product of the Inchinnan Airship Works of the William Beardmore & Company, Ltd. Construction was begun in the early part of 1919, following the completion and handing over of the "R-34." Completion was deferred, owing to changes in airship policy.

In brief, the "R-36" is 627 feet in length, which is approximately 40 feet less than the length of the "R-34." The maximum diameter of the ship is 78 feet 9 inches. It has a maximum gas capacity of slightly over 2,100,000 cubic feet, giving it a nominal lift of 63.8 tons. The maximum speed is 65 miles an hour, while its normal cruising speed is slightly over 50 miles an hour. It has a maximum range of action of over 4,000 miles. However, the economic range varies according to the number of passengers and the weight of the freight carried.

The design is quite similar to the well-known Zeppelin rigid type, with a gas-containing hull comprising a stream-line skeleton framework of light metallic girders, covered over with heavy fabric. The hull is divided into nineteen compartments, each containing a drum-shaped gas bag. Each gas bag has an automatic gas release valve, while some are fitted with a manually-controlled valve, in order to discharge gas while landing or to alter the trim of the ship. Inside the hull and along the bottom runs the gangway or "cat walk" for the entire length of the ship. The petrol tanks and water ballast bags are arranged along this gangway.

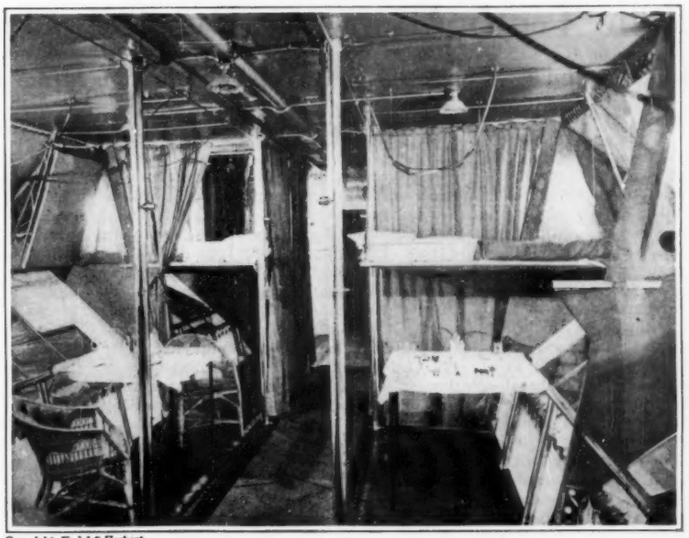
The "R-36" is fitted for mooring at a mast, and at the extreme bow is a trap door, opening outward, which enables passengers and crew to pass to and from the mooring mast when the ship is safely moored. Six cars, five of which are designed to take power units, the sixth being a passenger car, the forward portion of which is used as the control car, are also features of this British airship. Two of these are "wing" cars, placed near the bow of the ship, each containing a 260-horsepower Maybach engine driving direct a two-bladed propeller. The passenger car is placed almost amidships and opposite its center are fitted two or more wing-power cars each of which contains a 350-horsepower Sunbeam "Cossack" engine. The fifth power car is on the central line of the ship, toward the stern, and also contains a 350-horsepower Sunbeam. Each of the three Sunbeam engines drives through a reduction gear and clutch a large two-bladed propeller. These power units give a total of 1,570 horsepower, which is substantially more than that of the "R-34."

Four large fixed stabilizing fins are fitted at the tail of the ship, comprising two vertical and two horizontal members.

An entirely new departure in British airship construction is the fitting of a passenger car which has been designed to accommodate 50 passengers. The car is 131 feet long. It is provided with a passage way that runs down its center. On each side are cabins which are furnished with beds for two passengers, a table and chairs as shown in the accompanying illustration. The general arrangements of the cabins are such that each passenger is provided with a clear and unobstructed view, both inside and outside. The cabins are divided off by curtains at night, which may be drawn back during the day and the beds folded up. The car is also fitted with a cook's galley and a pantry, which are situated in the center of the ship. Good washing and lavatory accommodations are also provided.

A normal crew of four officers and twenty-four men is carried. The officers consist of a captain, first officer pilot, second officer pilot, and engineer officer. The crew consists of 2 coxswains, 7 riggers, 13 engineers and 2 wireless operators. The crew is divided into watches which take alternative spells of duty and rest.

The "R-36" is to be used for long-distance air service, in which it is certain to effect a great saving in time over existing transportation systems. On the England to India service, for instance, the airship voyage would require approximately six days as compared with the fastest overland and mail route of twenty-one days. The "R-36" promises to surpass the service of the German passenger airship, "Bodensee."



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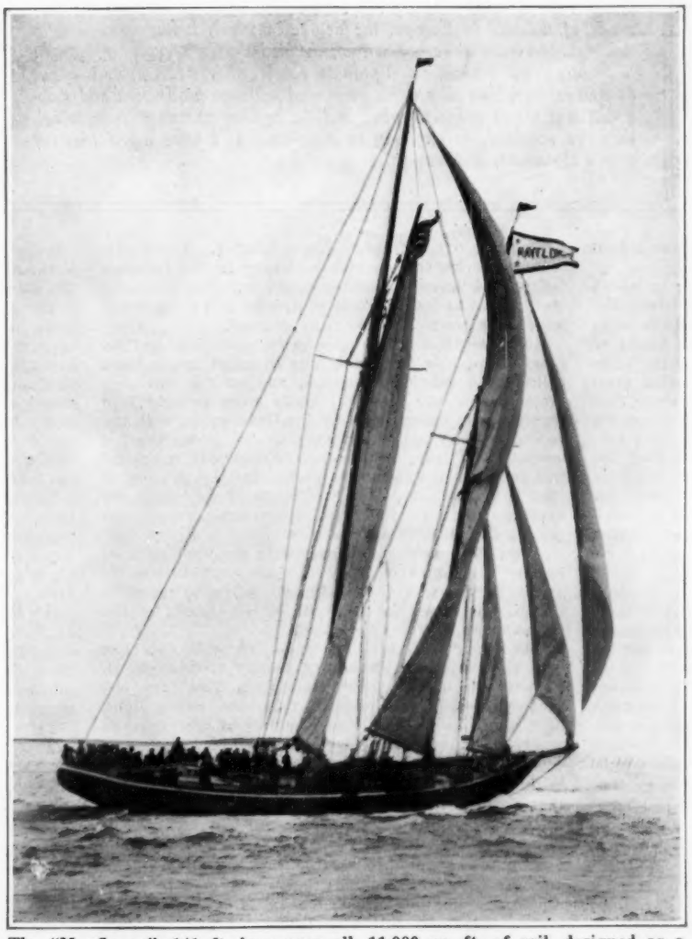
Passenger quarters in the British airship "R-36" which is now available for regular commercial service



The "Mayflower", 141 ft. long over all, 11,000 sq. ft. of sail, designed as a competitor this summer for the annual fisherman's race

Circumventing Orange Thrips by Cleaning Orchard

THE thrip is an insect of economic importance which does extensive damage in orange groves. Although a thrip-scarred orange is exactly as good to eat as a clean orange, the appearance of the fruit, and its consequent selling value, is very much reduced. Any orange grower will tell you that a big crop of thrip-scarred oranges will bring less than a small crop of clean fruit.

A logical orange grower had heard many times that dead leaves and litter in the vineyard were a serious peril, because they sheltered injurious insects. He reasoned that what was true for grapes might well be true for oranges, and straightway made it an annual practice to rake his orange orchard free of leaves and litter late each fall. Intelligent farmers often conduct such experiments for themselves, from long experience holding themselves ready for any result. They realize that some little factor, not taken into account, may destroy the strength of their whole argument.

But this orange grower who fought thrips by raking up leaves and litter each November met with success beyond his expectations. He has followed the practice for several years now, and his orchard produces the cleanest fruit in the whole district. The past season the thrip-scarred oranges averaged not more than one or two to each tree. Other orchards, unraked, in the same locality and growing under similar conditions, suffered heavy damage from thrips.

This grower is conservative. He believes he has hit upon the ridiculously simple, remarkably inexpensive, way to control thrips, and certainly results seem to bear him up. But he suggests that before accepting the experiment as conclusive demonstration, other orchardists should try it out. They will, too! The solution of many an agricultural problem is so simple that it hides, as it were, in its own simplicity. At any rate, it would seem that this simple expedient of clearing the orchard of leaves and litter is nothing more than what has long been done in other lines to avoid insects.

"Mayflower", Challenger for International Fishing Schooner Cup

JUST at the very time when the ultra-refinement of the hulls and spars of yachts built for the America's Cup races had been carried to the point of absurdity—as witness the refusal of "Resolute" and "Shamrock" to race in the only decent breeze that came their way last summer—at this very time the stout, down-east fishing schooners of Massachusetts, Maine and Nova Scotia came to the rescue.

These craft are staunch, able, strongly-built schooners, which are perfectly at home in the heaviest water that may come their way in the Atlantic, and at the same time can do their 12 to 12½ knots as they race to the westward to carry their catch to the home markets.

Last year's fisherman's race went to the American schooner, and new vessels are being built for the races of the coming summer. Boston has entered the lists by building the handsome schooner of which we show an excellent illustration. The "Mayflower," as she is called, was designed by W. Starling Burgess, well-known son of a famous father, Edward Burgess, who was the designer successively of the "Puritan," the "Mayflower," and the "Volunteer," all three of which successfully defended the America's Cup. Everybody will agree that so far as this picture can tell the story, the "Mayflower" is an able boat with a handsome sheer, high freeboard and a well-cut suit of sails.

With each succeeding contest the competition will grow keener, and the successful schooners will be a little faster than their predecessors. If there should be some good spanking breezes for this season's struggle, it is quite possible that records for speed, in reaching at least, will pass from the America's Cup to the Fishing Schooner Cup class.

The Truth About the Dye Industry

Its Achievements and Its Status, and What Its Continuation Means to America

By H. Gardner McKerrow

THERE is nothing which enters so completely into the daily life of man, and is more essential to his contentment of mind, than color. Color is to the mind of man what salt is to his food.

Imagine, for instance, what this world would be like if all artificial color were eliminated from our daily experience, from our clothes, the decorations of our houses, the woodwork with which we are surrounded, and the magazines and books which we read. Suppose that everything was a dead, toneless white, relieved only by the light and shade caused by reflections. This is the actual condition with which we were threatened upon the outbreak of the European war in 1914.

Prior to that time we, and all other industrial countries, were entirely dependent upon coloring matters coming from Germany, and our complete line of textile fabrics, paper, leather, woodwork, paints, pigments, varnishes and everything else requiring color, drew their tints from the products of the great German dye-making plants.

The discovery of coal-tar colors was made in 1856 by an Englishman, William Henry Perkin, but the development of the coal-tar industry very quickly passed into German hands, so that by 1875 England, France and the United States had become content to leave the development of this fundamental industry entirely with German chemists.

Prior to 1914, as far as the United States was concerned, there were only five firms engaged in the manufacture of coal-tar dyes, and these depended for the most part, on intermediate products obtained from German manufacturers. It may readily be supposed that these German manufacturers only allowed such of these intermediate products to come over here as would produce colors which could not, under any conceivable circumstances, compete with the finished German products. The business here was not a profitable one, and with the single exception of aniline oil, no coal-tar product made in this country could be considered as having created a place for itself on a competitive basis.

The German dyestuff houses established their own depots of distribution and their own laboratories in this country, and the technical service which they rendered to the dye consuming trades reached such a state of organization that our color users were riveted almost inseparably to the German manufacturers.

When war was declared in 1914, this supply on which more than $5,000,000,000 worth of our industries depended, was instantly cut off, and no dyestuffs were available other than what remained in the hands of the German agents or in the warehouses of the mills themselves. Immediately a condition bordering upon panic developed and prophecies were freely made that we should be reduced to the condition of a white world with color entirely eliminated from our every day life. The very floors of the warehouses were scraped for color, all kinds of blends and mixtures were made to get desired shades, and dyestuffs utterly unsuited for the required purpose were used. Dyestuffs intended for dyeing cotton were used for dyeing wool or silk, and blends and mixtures were made that would not resist even the action of cold water.

An interesting illustration of this was an instance which occurred during those hectic times, when there was an absolute shortage of dye for coloring stockings. One large hosiery manufacturer succeeded in getting hold of a large lot of brilliant black dyestuff—which by the bye, was German dyestuff—made and intended for the express purpose of dyeing casket cloth, and the only requisite of which was that it should give a brilliant glossy black, with no requirements as to fastness against light or washing. It is intended, in fact, to be black only during the brief period of use; after that there are no complaints. He dyed up several hundred thousand pairs of stockings with this dye, and the result was that the first time that these were washed they turned olive green. This was used as a flagrant instance of the poor quality of American dyes.

Our mills were forced back into the use of the natural dye woods which our forefathers used, and which, on the advent of the coal-tar dyes had passed almost completely out of employment. Such dyeing materials as log-wood, quercitron, fustic, hypermic and natural indigo were called for and methods of dyeing rejuvenated which had been forgotten for years. The machinery for using this class of dyes had largely been done away with in the mills, and this also had to be replenished at a time when the mechanical industries of the country were being called upon to the limit of their resources for war purposes. The forests of Mexico and Hayti were ransacked for anything which would yield color and every conceivable vegetable growth having any natural coloring value at all was experimented with for the purpose of obtaining the tints called for by our mills.

Prices soared to unheard of limits, and dyes which before the war were sold at 20 cents and 25 cents a pound very quickly rose to $2, $5 and $10 a pound. Some romantic stories are told of the fortunes made almost overnight in the dyestuff business during the years 1914, 1915 and 1916, and everybody that could get into the dyestuff manufacturing business did so. Instead of five firms being engaged in the manufacture coal-tar products, there came to be in less than eighteen months, 127 engaged in the making of dyestuffs and about 218 engaged in the making of coal-tar intermediates. Many of these firms had no moral or economic right to be in the business; they did not have the necessary capital or the necessary chemical experience and knowledge, nor did they have the plants for making dyestuffs of a proper quality. The legitimate concerns, those which had been in the business before and knew something about it, were straining every nerve to develop their equipment and place themselves in a position to meet the demand.

THERE has been a great deal said, since 1914, about dyestuffs and the industry that makes them. Some of this has been outright German propaganda, much of it has been more or less hysterical in its nature. We believe it altogether in order to make a plain statement of what the dyestuff industry has been called upon to do since the outbreak of the war in Europe, the degree to which it has succeeded in doing it, and the precise position which this industry occupies and ought to occupy in our economic and political fabric. Mr. McKerrow is about as well informed on all matters connected with the production and marketing and use of artificial colors and the coal-tar chemicals from which they are obtained, as anybody in America. We have asked him for such a statement; and here it is.—THE EDITOR.

How difficult this was may be understood when it is remembered how completely our chemical trades were called upon for war purposes, and as the war progressed, how our chemical staffs were brought into requisition in order to supply the Government with the necessary chemical supervision in the production of munitions of war. Upward of $200,000,000 of capital was invested in dye-making plants, and by the end of 1917 a very considerable percentage of the supply of dyestuffs called for by our color consuming trades was coming from American factories.

There is no mysterious alchemy in the production of dyestuffs; a given chemical formula, provided its ingredients are of satisfactory purity, will give the same result, whether it is employed on the banks of the Rhine or in Buffalo, New York.

The term "fast" used in connection with dyes has been one which has been very greatly misunderstood. The average layman understands by a "fast" dye, one that will resist any and all reactions, either light, acid, alkali or washing. As a matter of fact, there is no dye—and never was a dye—which will fulfil all these conditions. Even the German dyes may be fast to one thing and not fast to others. It is not generally known that there never was a single pound of German dye ever imported into this country which did not carry the stipulation "without guarantee."

Prior to the war this was the condition on which all our manufacturers bought their dyes, but they accepted the situation without demur, as the German dye makers were the only sources from which the dyes could be obtained, and they themselves were willing, while using the German dyes, to guarantee their goods.

There has been so much publicity, and so much false and uninformed writing about this point of fastness however, that questions are being asked and stipulations are being made, which were never imposed on fabrics dyed with German dyes prior to the war. It is simply because of this publicity that so many of our retail stores have put notices on their goods such as "these goods cannot be guaranteed because they are dyed with American dyes."

American dyes have been made to carry the burden of all kinds of faults; faults of improperly mixed stock, faults of spinning, faults of weaving, faults of finishing; all have been passed down the line and have been loaded eventually on the long suffering American dyes. This is a condition which only has to be called to the attention of a patriotic American merchant, and in most cases he very readily and gladly removes these misleading notices.

As the new dye industry becomes more standardized and is able to give sufficient time to the working out of the intricate problems involved, the education of the American dyer will proceed apace and these difficulties will be eliminated one by one. We are justified in saying, however, that the three hundred individual dyes now made by the American dye manufacturers are class for class, and type for type, just as brilliant, just as fast, and just as reliable as the corresponding types of German dyes.

This does not mean that in the brief space of five years we have been able to make all the dyes which were formerly made in, and imported from, Germany, but we can have a feeling of justifiable pride, as patriotic Americans, in the fact that in one-tenth of the time that was taken by the German manufacturers to build up their coal-tar industry, we have reached a point where we are supplying practically all the colors commonly required for use in the daily life of the nation, and that there is but a short way to go to make our line as complete and fully developed as the German line ever was.

If the industry is permitted to live, and is not placed in a position where it can be wiped out by ruthless foreign competition, we are justified in believing that in a very few years from now, the coal-tar chemical industry of America will be doing everything industrially which was ever effected by German interests. So much for the industrial side of the question.

There are other aspects, however, which are even more important than the individual interests of a certain number of our manufacturers. In the world's history, we have passed through a stone age, a bronze age, an iron age, a steel age, and we are now in a chemical age. Chemistry is entering into practically every branch of industrial manufacture. It will be called upon more and more for analysis of manufacturing conditions, and for synthesis in putting together the ingredients for achieving new purposes.

In order that this may be done intelligently, it is necessary to build up a thoroughly trained class of research chemists. Now, where are those chemists to come from? Certainly our colleges, even our technical schools, cannot be depended upon to produce them. No matter how well equipped or well organized these educational institutions may be, they can never do more than give young men the initial training in theoretical work. The practical application of this theoretical training must be done in some industry, the requirements of which are such that this work can be utilized in a commercial way.

There is no such industry, except the coal-tar chemical industry, and the collateral chemical manufactures that go with it. No other industry could afford to spend the necessary time and money on experimentation and the working out of complicated chemical processes. Given this necessary training in chemical research, the utilization of by-products can be elaborated and this brings us at once into a vast possibility of usefulness for the coal-tar chemical industry—which in itself would go far to justify its maintenance and protection—through the development of the by-products

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The Giant of the Skies

The Size and Distance of Betelguese, and a Few Other Items of the Astronomer's Daily Business

IT means little to us to be told that Betelguese is 300,000,000 miles in diameter—little, that is, so far as concrete visualization of this huge size is concerned. We have a profound conviction that three hundred million is more than two hundred million, and less than four hundred million; but just what any of these figures mean, and just what the actual difference between them in concrete terms may be, is something that is by no means easy to comprehend. It is really necessary to build up from small beginnings in order to get any adequate idea of the size of this huge sum.

Even the attempt to make a comparison of some sort, graphical or statistical, is not one that will be necessarily and immediately successful. Anything, no matter how large it be, that is small enough for us to grasp readily and use as a basis of comparison, is pretty apt to be so very minute in comparison with Betelguese that the attempt at comparison leads us to a figure meaning little if any more than the 300,000,000 with which we started. An idea of the difficulty which inheres in the effort to get results in this direction may be gained if we try to compare Betelguese with the earth. The earth is a pretty good-sized affair, as things go in our ordinary life; it is probable that most of us have a fairly definite idea of what its 8,000-mile diameter really comes to, and rather doubtful that we have an equally clear visualization of anything much larger. But if we represent Betelguese by a sphere of 9 inches diameter, the very largest one that we can possibly crowd upon our opening page which is specially dedicated to displays of this sort, we find that the poor old earth will shrink to dimensions a good deal less than those of a pin-point—1/40,000 of an inch to speak in the round numbers which alone have any significance in the presence of a quantity determined no more accurately than is the diameter of Betelguese. We can't distinguish, on the printed page, between a point 1/40,000 inch and a point 1/400 inch in diameter—except perhaps on the ground that the one we can see, and the other we cannot manage to see at all.

We are in a good deal the same predicament as that portrayed by one of the Einstein essayists, who wrote, apropos of the extremely small alterations in ordinary measurements called for by this theory, that while to be sure we can measure a million miles, and equally a millionth of an inch, we can't measure both these distances at the same time and place and with the same instruments. The difficulty in getting a graphic statement of Betelguese's size is altogether that of finding something comprehensible which can stand alongside Betelguese and be measured at the same time and place and with the same instruments. We believe the drawing which we present on the first page of this issue represents the most successful attempt yet made to do this.

The orbit of the earth and those of the other minor planets to be sure represent quantities with which we are not on excessive terms of familiarity. Yet we can build up to them without undue strain or undue lack of clarity. The earth, for instance, travels in its course about the sun at an average speed of 18½ miles per second—1,100 miles, or much more than the distance separating New York from Chicago, in a brief minute. This ought to give us some notion of the distance traveled by the earth in a year, which for the sake of those who want to be cautious we may state contains something like half a million minutes—one for every 10 feet of the long distance between New York and the metropolis on Lake Michigan. Yet when the long and weary path which these figures indicate for the earth's annual journey is bent around into a circle, we find that this whole circle with the vast expanse of empty space within it can be accommodated inside the solid (or liquid or gaseous) shell of Betelguese—accommodated so comfortably, in fact, that there is margin sufficient to admit the next planet beyond us—Mars—with his orbit that is pretty nearly half again as big as ours! That, roughly, is the state of affairs indicated by our drawing, which is laid off to scale with extreme care.

We shall have to admit one exception to this. The little boy and the elderly gentleman whom we have employed as further illustration of Betelguese's prodigious size are not drawn to scale; we shall not attempt to conceal this fact from the inquisitive reader. We shan't apologize, however; we consider that the reasons for our failure to pursue consistency to the ragged edge and over the edge are sufficiently obvious. Let it be merely repeated here what is briefly suggested around the edge of our drawing. The greatest muzzle velocity attained in any regularly manufactured handrifle to date is 2,800 feet per second—approximately a mile in two seconds. If we take this velocity as standard; if we pretend that it were possible for a bullet once started at that speed to maintain it indefinitely; and if we so ignore the facts of gravitation as to suppose that such a bullet once started parallel with the surface of Betelguese could maintain this parallelism, traveling in an orbit that would carry the bullet eventually back to its starting point instead of bringing it to "earth" a short distance away from the point of discharge—then we have all the raw materials of our second attempt to put Betelguese's size before the reader. The fact is, that at this high velocity, a bullet shot around the star by a boy of 14 would not complete the circuit and hit the marksman in the back of the neck until he had attained the ripe old age of 70—it would be 56 years in flight.

There is really more of interest about Betelguese than the mere figure stated for its approximate size. It is so remote from the earth that, even when viewed from opposite ends of the 186,000,000-mile base-line provided by the distance across the earth's orbit, it appears to lie exactly in the same direction—in technical terms, its parallax is not observable. This means that the trigonometric method of determining its distance, which is the most accurate of the several devices employed by the astronomer for this purpose, is not available; and we must descend to a comparison between its apparent brightness as measured photometrically, and its probable real brightness as deduced from what the spectroscope tells us about it. But this means that there is a very considerable margin of error, since the determination of real intensities in this way is based upon theories which have not been and proba-

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"Einstein's Theories of Relativity and Gravitation"

The Book in Which Is Collected the Material Brought Out by the $5,000 Prize Contest

SOMEWHAT later than expected, but we hope better for the delay, and none the less welcome because of it, the volume presenting the results of the Einstein Contest is now ready for distribution. The effort has been made to get into these pages everything of value that has been brought out by the competing essayists. This, on the grounds of space alone, has necessitated the enforcement of a rigid policy of excluding everything that at all smacked of duplication. There were essays that were as good as some of those chosen for inclusion in the book; but essays whose viewpoints were covered, collectively, with such completeness by the ones selected as to make their inclusion impossible. There were likewise essays which were amply good enough in their entirety for inclusion without the elimination of parts which were adequately covered in other essays; but the demands of space necessitated the elimination of such parts. To all the contestants whose work was good and yet not sufficiently distinctive to be got in, *in toto*, we wish to express our appreciation and our regret that they could not be accommodated.

The reader will doubtless be surprised, on opening the volume, to find that Mr. Bolton's $5,000 prize essay is not given the position of honor at the head of the procession. It does as a matter of fact precede all the other complete essays that are printed; but it has been judged advisable to precede it by several chapters of introductory material. The very excellent reasons for this are set forth in the preface and need not be repeated here, beyond the bald statement that the subject is one on which it is not fair to ask the layman to read without a certain amount of preparation. This the introductory chapters are designed to give him, and it is earnestly hoped that the hint offered by their position will be taken, and that they will be read before the essays which follow them.

The chapter embodying this preliminary material seem to us to constitute, alone, ample justification for the book. The vocabulary of relativity, both with respect to its actual words and even more so with respect to the ideas which these words attempt to convey, is altogether new and strange to the layman. Things are done, offhand and without explanation or apology, which it would never occur to him were permissible. The shock to his common sense is too great; and the writers on the subject whose work we have seen have, with few exceptions, failed to make any sufficient effort to mitigate this shock by subjecting the reader to it gradually. These chapters are written with the idea that it ought to be entirely possible to get any intelligent layman into a frame of mind in which he can form an appreciation of relativity; and we believe they establish the validity of this belief.

Everybody who has read the proofs on this part of the book has commented upon one feature, and inasmuch as this is a feature on the attainment of which the Einstein Editor spent a good deal of time and thought, he does not feel inclined to let false modesty permit it go unmentioned. In these 150 pages passages from 49 of the competing essays have been used—passages varying in length from a fragment of a sentence to several consecutive paragraphs. To these the editor has added material of his own—sometimes just a few words to bridge the gap between excerpts, again several pages on an item which he wished to cover in greater detail than he found it discussed in any of the essays.

If we were asked for an *a priori* judgment as to the readability of a patchwork composition of this character, we could give but one—it ought to be highly unreadable. It ought to show its patchwork origin unmistakably. It ought to be chopped up to the last degree of discontinuity. But it isn't! We venture to state that in the absence of the reference marks identifying the various contributions, no reader would suppose for a minute that this was not the carefully executed work of a single author. One with great versatility of style to be sure, able to adapt his mood to the thing he wished to say and the vein in which he wished to say it; but one able to write with skill in any of his styles. Any single author might well be satisfied with a composition displaying the fundamental merits of unity, sequence, climax and proportion to the same degree in which they are here found. We believe these chapters to be one of the most striking editorial achievements which we have seen.

After this laying of the scaffolding over which the layman is to approach the subject has been completed, we come to the essays which are judged sufficiently good, and sufficiently distinctive in their presentation, to be given in full. There is the winning essay by Mr. Bolton of the British Patent Office staff, a model of clear and concise statement. Somewhat lacking in explanation as this essay has been found by some readers to be, its outstanding merit as a statement of the postulates of relativity and their consequences cannot be overlooked. It will not stand alone to tell the lay reader all he wants to know or even all he needs to know about relativity—the contest has borne out our impression that in 3,000 words this was not possible, and that the award of the prize would have to be made to the essayist who, from the many things that clamored for saying, should select the most significant things to say. That every word which Mr. Bolton says is significant should be the verdict of the reader.

After the winning essay we find 15 more of the competing essays in whole or substantial part. The preface assures the reader, and we reiterate, that no effort is made to arrange them in order of merit. The whole idea is to present them in the order in which they shall most advantageously show up the subject. They have been selected with extreme care, with the idea of eliminating duplication and securing a collective result which shall constitute as complete a discussion of the subject as was possible. We believe both selection and arrangement are worked out with success.

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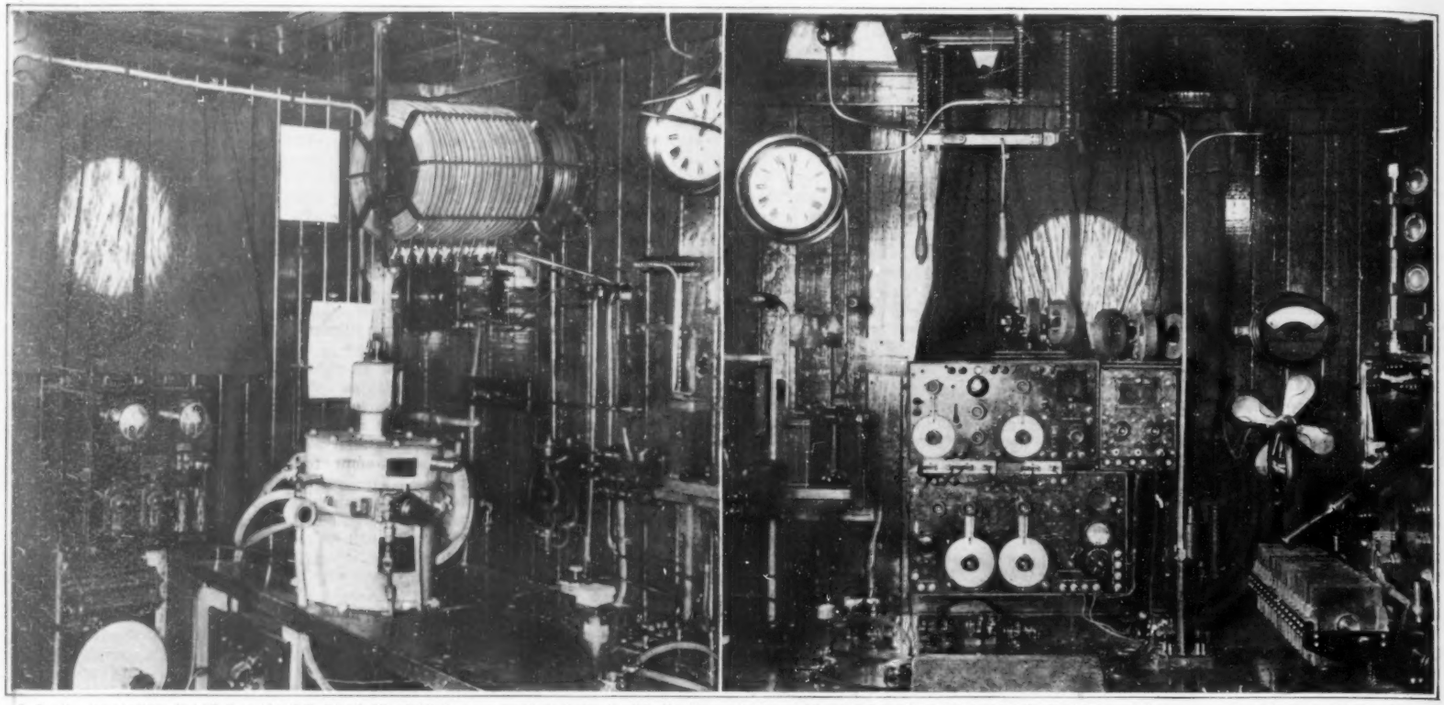

Left: Arc transmitter installed on the S.S. "Aeolus", which has communicated direct with the Navy station at Bar Harbor, Me., 3,000 miles in daylight, and has communicated nearly 8,000 miles at night, using the same amount of power as most marine installations. *Right:* The 2-kilowatt spark transmitter used on the "Aeolus" for emergency and for communication with South American stations which are not equipped for the reception of arc signals. The spark transmitter appears at the right. In the center is the receiving set, key and controls

Arc and spark transmitters employed on board the steamship "Aeolus", which has some remarkable records to its credit

Radio with the Arc Transmitter

The Remarkable Showing Made by This Type of Apparatus on the "Aeolus"

By Arthur H. Lynch

THE S.S. "Aeolus" of the Munson Line arrived in New York on March 28th, from South American ports. The movements of this vessel are being watched with much interest by those in the marine industry, because she has materially reduced the running time between New York and Buenos Aires.

In addition to clipping a few laurels for herself in the matter of speed, the good steamship "Aeolus" is also setting remarkable records in radio communication. She has been equipped with a 2-kilowatt arc transmitter and boasts a very efficient receiver.

An official report from the Chief Radio Officer to the company tells of direct communication with East San Pedro, California, the night the vessel left New York on her way south. On the same evening she also sent messages to and received from the S.S. "Venezuela," which was very close to Honolulu. Both these stations reported that the signals from the "Aeolus" were very strong and easily read.

From New York to Honolulu is approximately eight thousand miles, so that communication covering that distance, with a transmitter which does not require any more power for its operation than the ordinary ship set, is very remarkable. But even this great distance has not caused so much stir in radio circles as has the distance of 3,013 miles over which the vessel communicated in operating with the U. S. Navy Radio Station, at Bar Harbor, Me.

After leaving New York it was possible for the "Aeolus" to communicate directly with Bar Harbor, night or day, up to the time this record was reached, which is quite remarkable, to be sure.

Communication with the radio installations usually found on vessels, is a much simpler matter at night than it is by day, and though great distances have been reported heretofore, most of them have been accomplished at night. One theory for this difference in operating ranges is that there is a certain amount of energy absorption, caused by the sun's rays, during the bright hours. Many other theories have been exploited and some exploded.

The fact stands, in radio circles, that communication by night cannot be used in estimating the effective range of a transmitter, as it is always more or less "freaky." The significance, therefore, of the daylight range is what is relied upon.

It would indeed be generous to say that the average vessel has a daylight range of five hundred miles. Although communication has been covered up to greater distances, the instances are quite few and only have occurred in latitudes where there has been freedom from atmospheric disturbance. The nearer we get to the equator the greater becomes the atmospheric disturbance, called in radio parlance "static." And it is well known that the heavier the static the less possibility there is for communication by radio.

By projecting a line from Bar Harbor, Me., southward, we find that the "Aeolus" was not so far from the belt line of the world, when she was in daylight communication with that station. That is, in a position where receiving is admitted to be as bad as is possible and at a time of day when transmission is subjected to the greatest natural barriers, she sent to and received from Bar Harbor.

Considering that the operator overloaded the equipment a bit, in order to get through, we will say that three kilowatts were consumed instead of two. At the rate of ten cents per kilowatt, which is about the average charge made for electricity, the current used for this remarkable feat would cost thirty cents per hour.

Comparing this range with the ordinary daylight range of five hundred miles, which, as previously mentioned, is generous, there is an increase in distance of two thousand five hundred miles, which is five hundred per cent in favor of the arc transmitter over the less efficient sets.

The work being done by the "Aeolus" is being carried on by many other vessels of the U. S. Shipping Board fleet, which have been equipped with arc transmitters. In many cases unfavorable reports have been received by the Board concerning the operation of this form of transmitter, which, it is claimed, were caused by inexperienced operators or faulty installation, brought about by the rush of war. Many of the sets have had to be reinstalled, and the war-time operators, some of whom did not know the first thing about any

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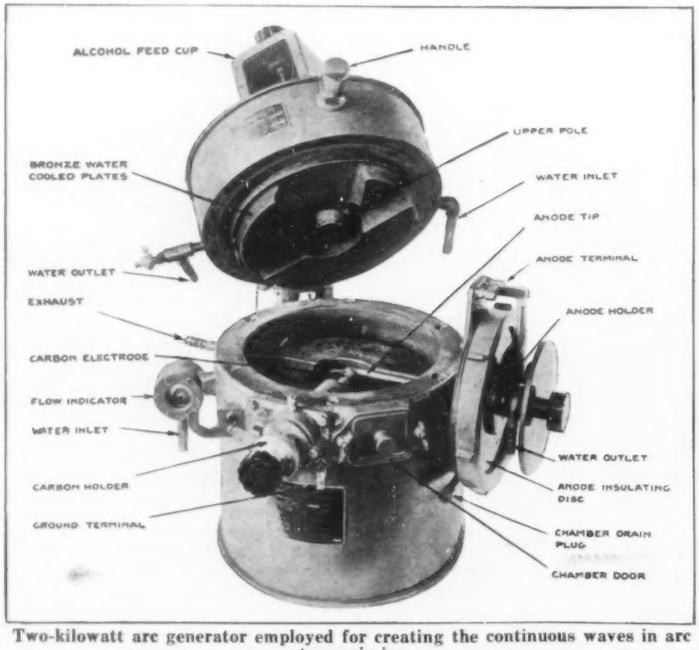


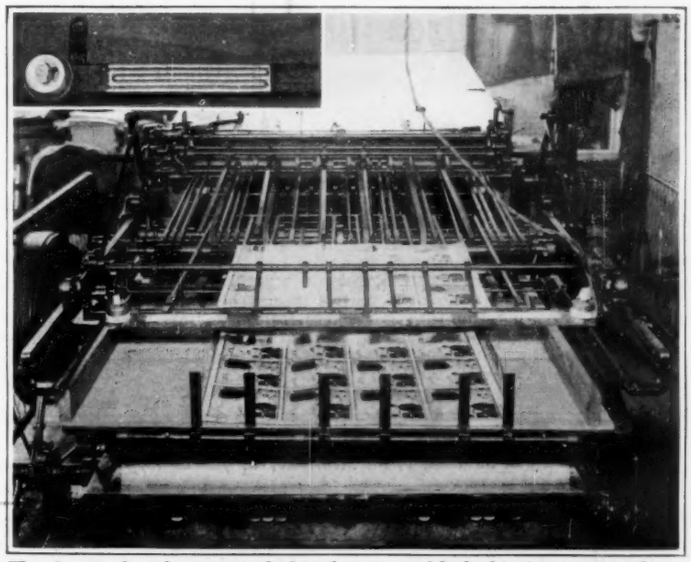
Two-kilowatt arc generator employed for creating the continuous waves in arc transmission

Mechanical Helps for the Printer

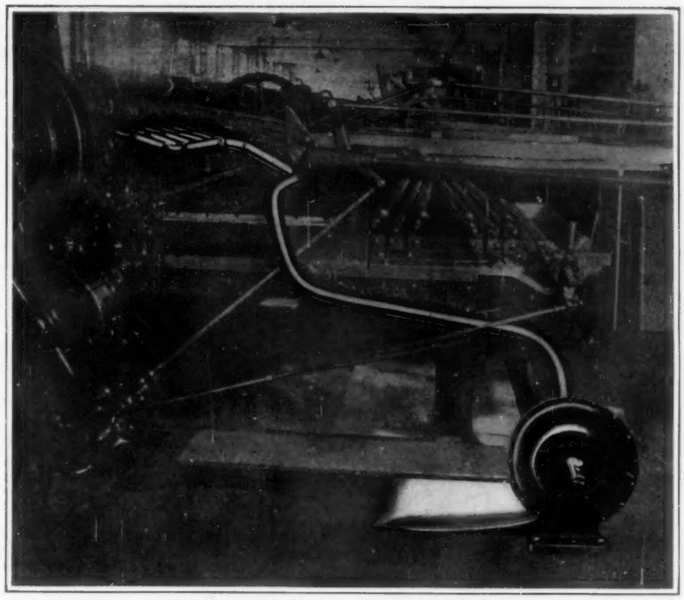
IN the business of printing there are many tricks of the trade that must be learned in order to turn out work that is up to standard. One of the most perplexing problems is that of keeping the sheets to be printed free from dirt and sediment before they touch the type form. If they are not absolutely clean there is no uniform inking and a clean impression is lacking. The printer has his troubles with the filling up of half tones, with sometimes a big resultant damage. To overcome this trouble, usually after a few thousand impressions have been run off, the forms must be washed. Mr. James E. Doyle, a practical printer of Cleveland, has perfected a vacuum sheet cleaner and when it is in use it is said that the washing of forms need be done but once or twice a day.

This device is very simple in design and can with very little trouble be attached to any cylinder, lithograph or offset press. It is operated by a small electric motor and has a series of suction nozzles. These latter are connected by rubber tube to a small suction fan. The nozzles operate on the press cylinder at a point where the paper starts on its trip through the press. Dirt, lint and other sediment is drawn from all paper and eventually finds itself in a canvas bag attached to the blower.

Static electricity is another source of trouble for the printer. If some attention were not paid to this trouble maker the printer would not be able to turn out his work as fast or jog the piles of paper as perfectly. For this purpose an electrical sheet heater has been brought out by this same gentleman. The heating element is of special construction designed for intense heat. The heating wire itself is of very recent invention and is the same as that used for high-temperature melting furnaces but is used for this purpose at one-third its capacity.



The electric sheet-heater attached to the press, with the heating member shown in the insert above



Vacuum cleaner that keeps the sheets clean, the impression uniform, and the plates free from clogging, shown attached, with the press in shadow

A Big Moving Job

TEN large-sized steel tanks having served in connection with the manufacture of high explosives near San Francisco during the late war were just moved a distance of 25 miles to be used in a more peaceable oil-supply station. In moving these tanks novel methods were used to save time and expense. Each tank measures 22 feet 9 inches in diameter by 10 feet high, not including the umbrella-shaped top which adds 2½ feet to the height. The bottom and shell are one-quarter-inch steel plate, the umbrella-shaped top No. 10 gage steel. The capacity of each tank is 30,000 gallons, and the weight is 16,000 pounds empty.

By means of 4-inch pipe used as rollers, with pipe flange at one end of the pipe to facilitate turning the pipe and moving the tank, each tank was moved from its foundation to the edge of a nearby bank, and tipped over the bank. After this it was quite easy to raise them further on edge by means of an auto truck pulling on a rope block and cable.

With the tank on edge, a rolling hitch with steel cable enabled the auto truck to move quite rapidly. Some of the tanks were moved in this manner half a mile over rough rolling country. Grading had to be done in a few places only.

To get the tanks to the water's edge it was necessary to cross the railroad tracks at a very busy point. The tanks were lined up ready to be rolled across the tracks at night, so as to give the least interference with train schedules.

After being moved across the tracks the tanks were rolled into the water and towed down San Francisco Bay. All ten of the tanks were towed at one time by a 110-horsepower launch making the trip against a brisk wind and part of the time against the tide, in eight hours.

New Use for the Telephone

FISH when they swim make a noise, and this can be detected by the telephone according to the following:

Most of us have watched with interest the movements of shoals of fish beneath the surface of the sea or of a lake, but few will have associated with those movements the idea of noise. Nevertheless, such movements do make a noise, and Norwegian fishermen, it is said, have taken advantage of that fact to devise an arrangement to assist them in detecting and locating fish at considerable depths. They lower a microphone by means of a wire from their boat into the water, the other end of the wire being connected with a telephone receiver on the boat. As the latter slowly proceeds on her course in search of a haul, an operator keeps the receiver of the telephone to his ear and he can tell instantly when a shoal of fish is being approached.

The Trend of Motor Truck Design for 1921

A PROMINENT eastern truck manufacturer who has built and tested trucks driven by chains as well as internal-gear and worm-drive axles has decided, as a result of these extensive experiments, to use an enclosed-drive rear axle which he calls a dual-reduction type. This axle employs only two gear reductions, four gears being used in a gear unit that is a compact assembly located at the middle of the axle and driving the wheels through conventional live-axle shafts. The rear axle is a full floating construction, the wheel being carried by two taper roller-bearings having opposed load lines, these bearings being placed on the outside of a strong one-piece drop-forged load-carrying member that has a wide yoke at the center, encircling the gear unit. The dual-reduction-gear arrangement is very similar to that type which is so popular in England, France and in Germany for use on subsidy-type trucks intended for heavy-duty work and adapted for immediate conversion to military service. The primary reduction is obtained by bevel-gearing while the secondary reduction is through a pair of spur gears. The pinion being mounted on the primary reduction shaft while the large member with which it meshes is attached to the differential housing assembly. Tests have shown that this dual-reduction gear is nearly as efficient as side-chain drive and more efficient than the worm-gear drive.

Left: **Tipping a tank over the bank to get it on edge.** ***Center:*** **A rolling hitch with steel cable enabled the tank to be hauled by auto-truck once it had been up-ended.** ***Right:*** **The tanks after being rolled into the bay and restored to a natural keel**

Moving ten big steel tanks by rolling them to the water

A Super-Dreadnaught as Target

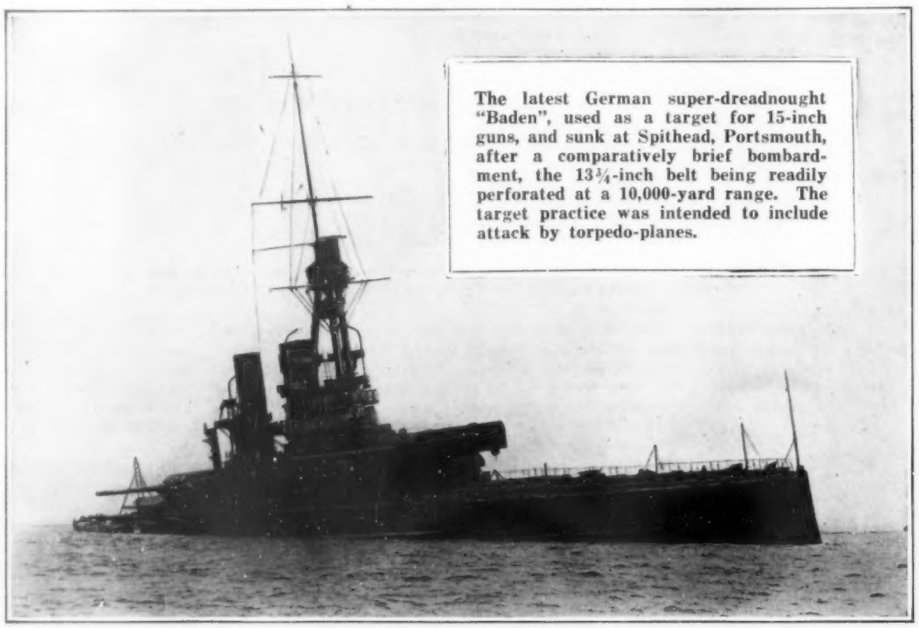
The Latest German Battleship "Baden" Sunk by Gunfire and Torpedo

By Hector C. Bywater

EARLY in February the ex-German battleship "Baden," which was among the former enemy ships allocated to Great Britain, was towed from Portsmouth to Spithead and there subjected to attack by gunfire and torpedoes. According to a semi-official statement issued on February 9, "the 'Baden' was subjected to short-range firing in the presence of gunnery experts, and also to aerial torpedo attacks. The object was to test the construction of German battleships and to throw light on the value of capital ships. The ship will be salved for further tests." The photograph reproduced herewith was taken soon after the conclusion of the experiments. As the first occasion on which a really modern war vessel of the largest dimensions has figured as a target ship, this experiment has created great interest in naval circles. The "Baden," which was laid down in December, 1913, at the yard of F. Schichau, Danzig, and commenced her trials in November, 1916, embodies the latest German ideas on battleship design. The "Baden" is 590 feet long over all, has an extreme beam of 98½ feet, and her displacement at 27 feet 8 inches, 28,074 tons. She represents the latest German ideas in battleship construction.

IT will be remembered that the terms of the Armistice, as far as they affected naval affairs, required of Germany that she hand over her fleet to be distributed among the Allies. The allocation of the ships was made with the understanding that certain larger units should be destroyed within a definite time. This condition is being fulfilled by using the ships as targets for attack by gunfire, torpedo or bomb. The accompanying article seems to dispose of the rather widely accepted belief that the German capital ships were possessed of defensive qualities which greatly exceeded those of similar ships in other navies of the world.—THE EDITOR.

As regards armor and protective plating, the "Baden" has a main belt 13¾ inches thick, which tapers to 6¾ inches at the lower edge. This is surmounted by a strake of 9⅞ inches armor extending to the upper deck, and the citadel is enclosed by transverse bulkheads. Beyond the main belt there is plating of 6 inches up to the bow and stern. The secondary battery is armored with 6¾-inch plating, the deck above the battery being about 1½ inches thick. Deck protection is less substantial than might have been supposed. The protective deck proper is only 1 3/16 inches on the slope, but abaft the citadel this deck increases in strength till it reaches its maximum thickness of 4¾ inches over the steering gear. Forward of the main belt the protective deck is 2⅜ inches thick. The barbettes have a maximum thickness of 13¾ inches, the turrets being 13¾ inches thick at the front, 9⅞ inches at the sides, and from 4 inches to 4¾ inches on the roof. The forward conning-tower is built up of 13¾-inch armor, with a 5⅞-inch roof. The coal bunkers are so arranged that they extend all the way above the protective deck from the foremost to the aftermost barbette, and when filled with coal add considerably to the sum total of protection. Armor gratings of the usual pattern are fitted to all openings in the forecastle and protective decks. So much for the defense against gunfire.



The latest German super-dreadnought "Baden", used as a target for 15-inch guns, and sunk at Spithead, Portsmouth, after a comparatively brief bombardment, the 13¾-inch belt being readily perforated at a 10,000-yard range. The target practice was intended to include attack by torpedo-planes.

In the "Baden," as in every other German warship of modern construction, great pains have been taken to minimize the effect of submerged explosions, an object facilitated by the generous beam of the ship. The principal defense against torpedoes consists of a longitudinal bulkhead which runs throughout the major length of the ship. It has a uniform thickness of 2 inches, and is closed at each end by 1 3/16-inch athwartship bulkheads. There is, in addition, a very elaborate system of pumping and flooding, which war experience showed to be more effective than mere passive resistance by means of subdivision. When the ship went into action the commander was posted at a station below deck, where his sole duty was to keep the ship on an even keel. From his central station he could communicate by voice-pipe and telephone with the pumps, sea-cocks, and auxiliary leak-control stations. A pendulum showed him at a glance the exact trim of the ship, while a diagram board indicated the quantity of water which could be admitted to each compartment and the effect which flooding would have on draught, heel, and general trim. The whole ship's company had been thoroughly trained in this work, partly by periodical drill and partly by means of an instructional model, which reproduced in miniature the subdivision of the hull. Thanks to these careful precautions German ships which received in action injuries of the gravest description were brought safely into port, the "Derfflinger" and "Seydlitz" after the Jutland battle being cases in point.

The "Baden" was armed with eight 15-inch, 45-caliber rifles in four center-line turrets; sixteen 5.9-inch 45-caliber rapid fire guns; eight 3.5-inch 45-caliber anti-aircraft guns, and three 23.6-inch submerged torpedo tubes. An interesting feature of the main armament is the extraordinarily light weight of the 15-inch gun, which weighs only 76.2 tons. On the other hand, the projectile is much lighter than that of the British 15-inch gun, weighing only 1,652 pounds as against 1,930 pounds. Its muzzle velocity is 2,625 feet-seconds, and at 16 degrees (the maximum elevation of which the "Baden's" guns are capable) the extreme range is 22,200 yards. Of the three torpedo tubes fitted, the bow tube is horizontal and located 19 feet below the load waterline, while the broadside tubes are depressed two degrees and set at an angle of 20 degrees before the beam, the centers of the tubes intersecting the ship's side at points 13 feet below the load waterline. The torpedoes used in this ship are believed to be the largest extant. Their diameter is 23.6 inches, the length 23 feet, and the total weight 2.16 tons, of which 551 pounds is represented by the bursting charge. Set at a speed of 28 knots these formidable engines have a range exceeding 14,000 yards.

Before being fired at, certain modifications are understood to have been made in the "Baden," and the foremost turret was removed. Few authentic details of the bombardment are available, but it is known that the vessel succumbed far more quickly than had been expected. According to statements published in the press, the firing ship was the old monitor "Lord Clive," which during the war carried a pair of ancient 12-inch guns and, subsequently, a single 18-inch gun, with which she shelled the German positions at Zeebrugge. For the "Baden" experiment the "Lord Clive" was fitted with a triple 15-inch gun mount, the first mount of this kind to be used in the British Navy. It is reported to be in contemplation for the four new battleships of the current shipbuilding program, which may therefore mount ten 15-inch guns in two triple and two double turrets, arranged as in the U.S.S. "Oklahoma"; or, possibly, twelve 15-inch guns in four triple turrets, corresponding to the arrangement of the U.S.S. "Indiana." On this point, however, there is no definite information, and it is by no means certain that the designs of the new type have been finally approved. Nevertheless, the fact that a triple mount for heavy guns has been made and experimented with marks a distinct epoch in the development of British naval ordnance and indicates the belated adoption of a system which has long been in vogue in the navies of the United States, Italy, Austria and Russia.

Although the "Baden" was shelled at short range, the velocity of the projectiles is believed to have corresponded to a range of about 10,000 yards. The effect was surprising in view of all that has been heard about the super-excellence of Krupp cemented armor plate made at Essen. Round after round cleanly perforated the 13¾-inch belt, and in some cases projectiles impinging at an oblique angle punched their way right through the thickest armor. Under this heavy punishment the great battleship soon displayed signs of distress. Water entering through the numerous shell holes 'twixt wind and water gave her a heavy list to starboard, and long before the specified number of rounds had been fired she heeled gently over and sank, coming to rest on the shallow bottom with most of her hull above water. It is not quite certain whether the torpedo-planes which had been detailed to administer the coup de grâce made their attack before or after the bombardment, but in any case one or more torpedoes were dropped from the air and are said to have found the target. Sir E. T. d'Eyncourt, the Director of Naval Construction, has stated that the "Baden's" armor showed a degree of resistance considerably inferior to that of British armor of the same dimensions. A further point demonstrated by the test was the great improvement which has been made in the quality of British armor-piercing shell since the Battle of Jutland. In that action, according to Lord Jellicoe, many shells broke up on striking the thick German armor, though there is photographic evidence that a large percentage got through and exploded with terrific effect inside the ships. Views have been published

(*Continued on page 420*)

Spacing Trains the Correct Distance Apart

ON a railroad where the traffic is exceptionally dense, such as the subways and elevated railroads of large American cities, it is quite a problem to maintain an even headway or interval between trains. The loss of headway by any one train throws more or less of the entire railroad system out of joint, for with headways measured in minutes and seconds the uninterrupted operation of trains is as delicate as a complicated piece of machinery.

Of considerable interest in this connection is the hedwaygraph—an instrument that furnishes a daily record of railroad headways. Several instruments of this kind have been installed on the subway lines of the Brooklyn Rapid Transit system in Brooklyn and Manhattan. The hedwaygraph, which is shown in the accompanying illustration, is circular in shape and 24 inches in diameter. Every 24 hours a fresh paper chart is placed in the instrument, being held in place on a revolving disk that is driven by clockwork. The disk makes one complete revolution in every twenty-four hours. On the chart are four circular sets of lines representing the tracks at the points selected for the recording of the intervals between trains. Radial lines divide the circular lines into 24 parts which represent the 24 hours. Between these hour lines are smaller ones which divide each hour into sections that represent one-sixth of an hour or ten minutes. At a fixed point directly above each of the four sets of circular lines is an electrode or "spark point" which, by the passage of a spark, marks the chart each time a train passes the chosen point and this makes a record in minutes of the intervals between trains.

When a train passes over the track at the point selected for checking up on headways, a relay connected to the track is automatically operated, which in turn operates two other relays in the chief dispatcher's office; and the action of these controlling devices is such as to energize momentarily an induction coil and produce an electric spark from the spark point above the chart. This spark produces a charred puncture in the chart about the size of a pin-hole. Thus each of these small holes represents a train that has passed over the track at the selected point and the distance between the holes on the revolving chart represents the intervals between the trains.

A Rocky Mountain Town Which Runs Its Own Plant

AN interesting example of municipal ownership of a public utility on a small scale which has apparently succeeded is presented in the experience of Longmont, Colorado, with its electric lighting and power plant.

Longmont is a pretty little town of 6,500 population, built on an elevation above the broad farming lands on the eastern slope of the Rocky Mountains, and is one of the principal gateways to Estes Rocky Mountain National Park. The business streets are well built and paved, with smooth boulevards stretching into the country, inviting the motorist, while the residence avenues are lined with tall trees and lighted by rows of electric globes on iron pillars down the middle of the avenues.

The first thought of owning an enterprise of this kind was stimulated by an article on "The White Coal of Switzerland" appearing in a leading weekly ten or twelve years ago. The rugged mountain scenery of the region may have suggested to the town lying along the base of the range that possibly similar benefits could be obtained by the development of its own natuaal resources.

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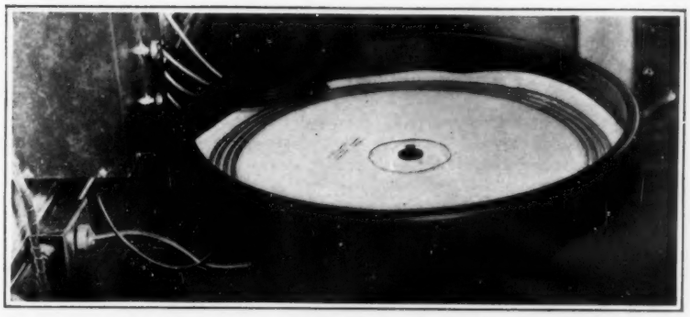
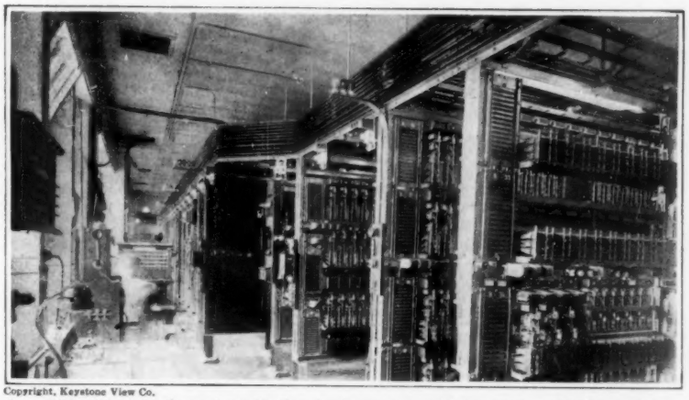


An instrument that makes a record of the headway between trains on one of New York's busy subway systems



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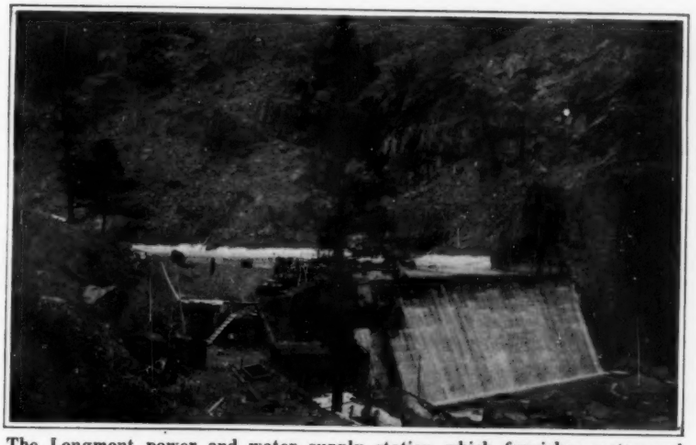
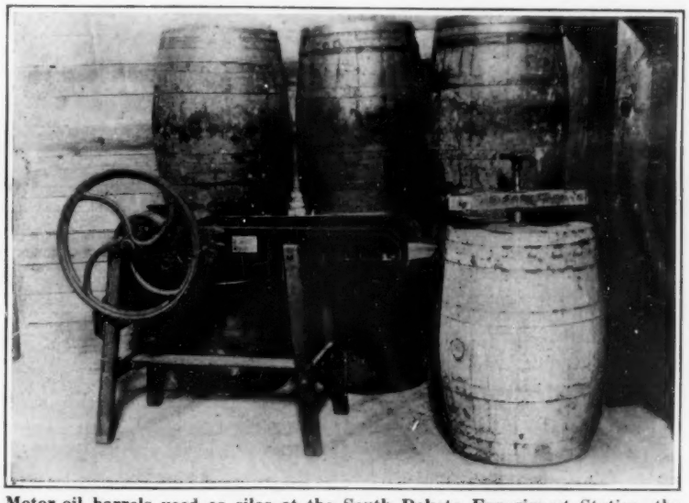
An automatic telephone installation in Germany which handles 10,000 numbers with only three operators



The Longmont power and water supply station which furnishes water and electric power to a Colorado community



Motor-oil barrels used as silos at the South Dakota Experiment Station, the hand-chopper being shown in foreground

The Automatic Telephone System Abroad

THE United States is not alone in the development and progressive application of the automatic telephone system. It appears that the automatic method of telephone operation is rapidly gaining ground in Germany.

The well-known Siemens industries for the most part have lately been transferred from Berlin to Spandau where many of them were already located. The co-ordination of such a vast grouping of industries into one giant organization naturally calls for an extensive intercommunicating telephone installation, and while in the past the private telephone system has been manually operated, it was decided to employ the automatic system at Spandau following the consolidation of all the Siemens industries. So remarkable is the present automatic system now in use at Spandau that conversations may be carried on between any two posts in the entire plant without manual aid from "Central."

The automatic system is not altogether new to the Siemens organization. Ever since 1913 the plant had been served by an automatic board which was capable of enlargement to 6,000 numbers without any serious structural changes. In Germany this is considered the equivalent of the telephone installation to serve a city of 200,000, though in our country with its much freer domestic use of the phone a similar claim would have to be made on a much smaller scale. The new central station necessitated by the latest move is one of 10,000 numbers, and requires the service of but three operators to do the few things which the mechanism is incapable of doing itself. It handles between 60,000 and 70,000 conversations per day.

The Electric Billy Goat and Its Work

OUR cover illustration shows a new type of electric "billy goat" hauling machine recently installed at the Beacon Park plant at Allston, Mass., for the Boston & Albany Railroad.

For coaling locomotives this railroad has a large coaling plant consisting of a frame building containing large hoppers over which is a standard gage track on which the coal cars are run. This upper track is reached by a long grade of 26½ per cent. A train of loaded coal cars is left on one siding and one car is pulled forward into position by a small electric car puller. When the car reaches its proper position, the small car puller is disconnected and the large electric hoisting winch is started. A "billy goat," which is of cast iron and which runs on wheels on a narrow gage track, is pulled by 1½-inch-diameter steel cable connected to the hoist drum. This "billy goat" normally rests in a narrow concrete trench between the rails, and when pulling is started, it

(*Continued on page 420*)

When Oil Barrels Become Silos

THE expense involved in establishing a costly, modern equipment for conducting numerous experiments with ensilage as a palatable food for cattle has been adroitly sidestepped by the Government. Instead of constructing a silo plant, with all its costly appointments, the Forage Crop Investigations, U. S. Department of Agriculture, acquired 10 motor-oil barrels at a cost of $1.50 apiece, and a hand chopper for less than $20.

The improvised equipment was stationed at Redfield, South Dakota, the experiments having begun in the fall of 1919, and will be in continuous operation for an indeterminate period. Preliminary tests were made with these mixtures: Alfalfa and corn, alfalfa and sorghum, and sorghum and corn. The barrels were filled on September 1, containing from 150 to 200 pounds of ensilage, and the con-

(*Continued on page 420*)

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

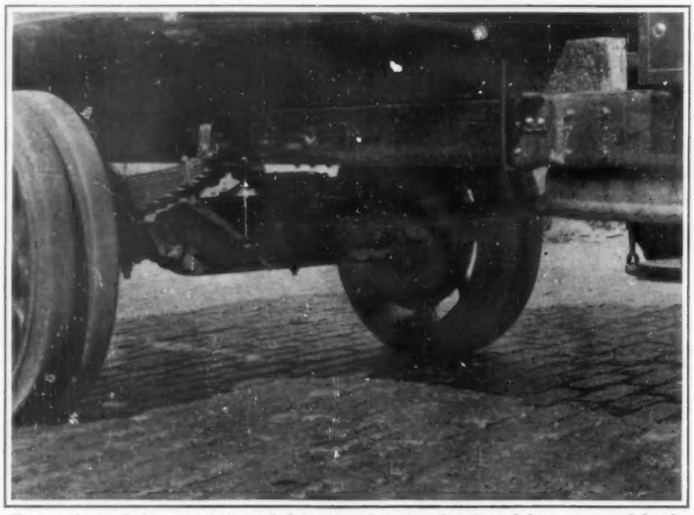
A New Internal Gear Drive Axle

THE popularity of the internal gear drive for motor truck use and its wide application in double reduction axles has stimulated design and development of this type, and various refinements have been worked out and applied in the construction of new axles recently announced. After an extensive and exacting series of tests, a distinctive and what has proved to be a very practical form of axle has now for some time been on the market. The mechanism, which is clearly outlined in the accompanying sectional view, is simple and compact; and while all parts are easily accessible, they are thoroughly enclosed, run in a constant bath of oil, and are exceptionally well protected from the destructive possibilities of the abrading action of road dust. There are no grease cups on the axle because the lubrication of all the internal mechanism is done by a simple circulatory system that cannot get out of order, since it uses no auxiliary parts such as pumps or delicate piping. Only such members as are found in all axles are given the added function of contributing to the oil circulation in both braking and driving mechanism.

Another feature that differs from conventional construction is the use of multiple disk brakes working on the live axle shafts, these being completely housed and working in a constant oil bath. The work of bringing the truck to a stop is distributed over a large number of lubricated faces, and it is evident that heating is reduced and that there is practically no depreciation because of the low unit pressure on the friction material. This design provides brakes of great efficiency and endurance, considerably less pedal pressure being required to bring the truck to a stop than is necessary with the conventional band-brake designs.

The brakes are operated by a simple toggle mechanism which acts as an equalizing medium as well, while the pressure is gradually and uniformly applied to both brakes simultaneously, a demonstration on a wet pavement convincing the writer that skidding due to uneven braking was eliminated by the combination of equalizing actuating mechanism and disk-in-oil brakes. A turnbuckle is included in each toggle link and adjustments can be made if extended service makes it necessary.

The oil circulation system through the brakes can be easily understood by referring to the accompanying drawing. Oil collecting scoops are placed in such relation to the bevel gear attached to the differential that lubricant is forced into them by the rapid rotation of the adjacent mechanism. This oil is directed to the interior of the brake disk carrier and is thrown to the periphery of that member by centrifugal force, passing through suitable holes and then between the brake disks, thus coating them liberally with oil. The oil supply is constantly renewed because the oil is thrown tangentially from the outer brake-disk carrier, finding its way back to the gear housing and again being picked up by the gear. Any heat absorbed by the oil is thus dissipated.

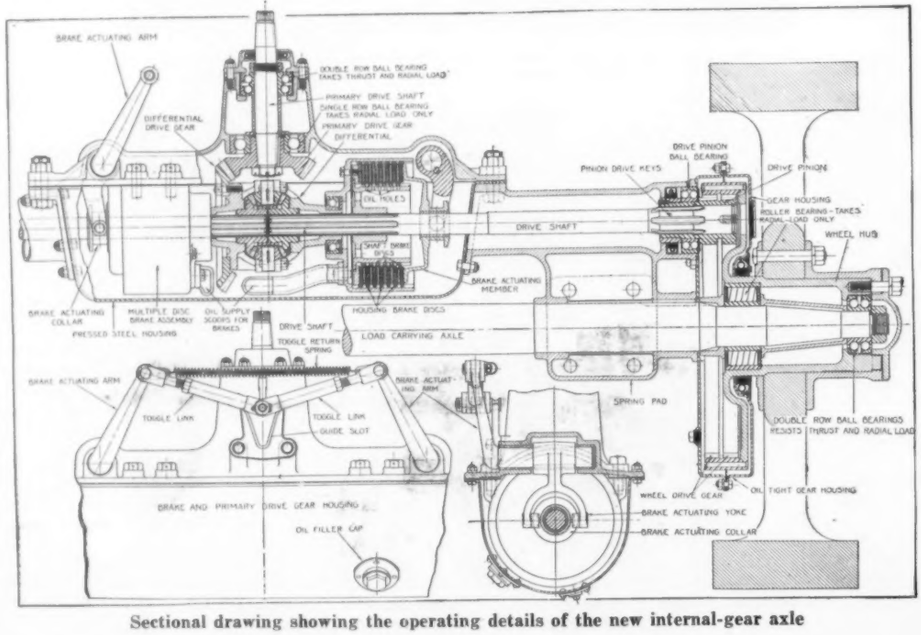


Front view of the new internal drive truck axle, showing drive gear and brake housings

It is said that the axle is free from noise because of the silent brakes and drive gearing as well as the absence of external unlubricated moving parts. Owing to the elimination of the usual large-diameter brake drums, the road clearance is exceptionally good and obtains at all points under the axle, it being as much at the wheel ends as at the center, a somewhat unusual accomplishment in double-reduction axle design. A clearance of more than 14 inches is secured with 36-inch solid tires.

The rear wheels are driven by herringbone gearing, which is very silent in operation and which eliminates end thrust. As the power is applied well toward the rim of the wheel, the gear tooth pressures are low. An oil-tight casing holds a sufficient quantity of lubricant to provide for extended periods of operation. The oil is carried up to the driving pinion by the large internal gear and thoroughly lubricates that member and its supporting bearing. Practically all the reduction is obtained at the wheel, so the differential mechanism and drive shafts may be made light without sacrificing strength, thus reducing unsprung weight.

The load carrying member is a one-piece, solid, drop-forged construction of heat-treated alloy steel. The hub is designed to take either wood or steel wheels and the assembly is such that a wheel may be dismounted without disturbing either the bearings or the drive gearing. As the axle embodies the Hotchkiss drive principle, the spring pads are attached to the driving-gear housing so the rear springs take all braking and driving torque reaction.



Sectional drawing showing the operating details of the new internal-gear axle

Truck Replaces Twenty Teams

F. O. SIMESON, of Limestone, Aroostook County, Maine, has a 160-acre potato farm situated 7½ miles from a railroad, yielding about 150 barrels of potatoes to the acre, or approximately 24,000 barrels. On account of a road grade between the farm and the potato storage house close by the railroad, he could haul only 20 barrels with one team of horses and make one trip a day. It would have taken him 1,200 working days with one team—just a little more than three years to haul his crop to market. In order to get it to the storage house in the 60 days available between "digging and snow" it would have taken 20 teams to do the job. If Mr. Simeson and every other farmer who hauled to this particular station had found it possible to secure 20 teams for the 60 days, it would have been impossible to handle that number at the unloading station. The haulage cost alone for this number of teams would have been considerably more than $6,000. Total costs would have been enormous.

Mr. Simeson was furnished with facts and figures concerning the operating costs and given an actual demonstration of the efficiency of the motor truck by the service department of a well-known truck concern that detailed an expert to study the problem. Convinced that the analysis of his problem was correct, Mr. Simeson purchased the machine and immediately began hauling 45 barrels of potatoes to a load and making 6 trips a day. In addition to this he made frequent night hauls to get his potatoes in the storage house inside of 70 days.

At the old rate of 25 cents a barrel for 24,000 barrels, this truck more than paid for itself in the 70 days it had to do the job. Every one of the 6,000 farmers in Aroostook County is a potato farmer and every one of the 80,000 people who live there is in some way or other dependent upon the potato crop for his livelihood. They are all potato specialists, and nothing is overlooked that can in any manner improve the quality or insure the certainty of the crop. They practice the most careful cultivation, make free use of fertilizers and utilize every machine that will reduce labor and transportation costs and increase efficiency in handling the crop.

Hauling the crop to market has always been a slow and tedious process. Twenty barrels make a full load and if a grower lives 10 miles from market one load a day is all he can haul. If he lives 5 miles, he is limited to two loads a day with a single team, for 20 miles is a full day's work for heavy hauling. Under these conditions the growers who live at any considerable distance from a shipping point are at a distinct disadvantage. They cannot take advantage of the market.

Putting Waste Metals to Work

(*Continued from page 405*)

while the non-magnetic substances are swept by momentum off of the belt when it begins its downward course. Disk separators are built capable of treating from 300 to 1,200 pounds of material in the course of an hour, and the magnetic-pulley pattern of separator, according to size, is able to take care, in the same interval, of from 550 pounds up to nearly 40 tons of waste. Apart from doing what is quite impracticable by manual labor, these separators recover values that otherwise would probably be lost. Magnetic pulley separators are extensively employed now in withdrawing iron and steel from blast-furnace slag, when crushed, and from the sand of foundries. Indeed, magnetic separators are reclaiming ferrous metals from ashes, grindings and sweepings, and helping to add largely to our stores of these secondary metals. So far, so good, but separation, in itself, does not suffice to insure the fullest reuse of the salvaged scrap.

Light, loose turnings, borings, etc., when remelted in that form, entail serious losses by excessive oxidation in the furnace. These can be minimized by compacting or briqueting the material in advance. Machines are built which effect this by subjecting the bulky scrap to enormous pressure, and the result is a dense mass which will undergo melting with nearly as little loss as a like weight of solid metal. This may be done either at the source of the scrap or at the nearest plant that specializes in the briqueting of such material. From there it is returned in the form of so-called ingots or briquets. These can be forked, dumped, and handled without appreciable loss by abrasion; they facilitate economy in the use of crucibles because their shape and density permit a maximum weight of charge; and they promote greater output of recast metal in less time and at a lower cost for fuel. One establishment has a briqueting equipment which turns out from 16 to 20 briquets of steel turnings per minute and these run from 12 to 20 pounds each. The light steel for these briquets is bought at the market price for such scrap and, after compacting, is sold at a premium above the market price for so-called heavy-melting steel.

That the Government set an example in economy is evidenced by what was done at the U. S. Naval Gun Factory where, during three years' work, it was found that manganese bronze, previously supposed to be an exacting composition, could be made without resorting to high-grade virgin metals. The alloy was produced in a reverberatory furnace from materials of low grade, such as yellow brass, machine-shop turnings, zinc dross from galvanizing pots, aluminum turnings, old zinc scrap, foundry-floor scrap and skimmings, and scrap copper. Similarly, the Navy Yard proved that open-hearth steel could be made from cheap unsalable scrap, and that a considerable saving could thus be achieved over the ordinary practice of utilizing practically all heavy and high-priced melting stock.

The use of lead batteries has expanded greatly through the development of the automotive industry and a large part of our secondary lead is obtained from old batteries. In 1919 the secondary lead recovered from various sources amounted to 122,100 tons. Considerable impure and low-grade lead scrap is now manufactured into toys here which previously came from abroad. Two years back the secondary tin salvaged was equal to about 42 per cent of the tin imported; it totaled 24,033 tons, and was valued at $29,868,200. Some of this was got from clean tin-plate scrap and about 400 tons was recovered from scrap tin, clippings, old tin pipe, tin foil, and collapsible tubes. Nearly all clean tin scrap is detinned by one of three processes—the electrolytic alkali, the chlorine, or the alkali saltpeter. By the

(*Continued on page 417*)

The Effect of Weight or Pressure

The demonstrated advantage that has resulted through the establishment of specific cutting speeds and feeds as most economical in the case of the lathe tool, points to the necessity of likewise determining the best working conditions for efficient Hack Saw work, as regards speed, pressure and lubrication for each type of saw and class of material.

The most vital variable under ready control is the pressure upon the saw,—which, other things being equal, determines the rate of cutting and the endurance of the blade. The proper weight to be applied on starting the cut, and when and how much it should be increased, varies with different makes of saws, and in the absence of recommendation by their makers can be estimated only by trial and by comparison of results.

The effect of pressure on the life of the saw and how it affects cutting costs is very clearly shown in the succeeding tables and curves. From all of these, it will be at once evident that too light a pressure will allow the saw to slide and wear without doing effective cutting. This may show long life in hours, but also requires long periods per cut, and results in an ultimate low efficiency. On the other hand, excessive pressure is unnecessarily destructive. The saw may cut much faster while it lasts, but it doesn't last long enough to justify the practice. Between these extremes lies the happy mean which represents the acme of Hack Saw economy. —From Hack Saws and Their Use, published by The L. S. Starrett Co., Athol, Mass., for free distribution.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

METHOD OF FIREPROOFING AIRCRAFT PARTS.—P. R. BRADLEY, 28 Chelsea Place, East Orange, N. J. The invention relates to fireproofing, and has for its object to provide a fireproof sheet between the first and second fabrics of an aircraft frame, and means for supporting the second fabric at a sufficient distance from the first fabric to provide air space between the fireproof sheet and the fabrics and thereby prevent carbonization should gasolene burn on the outer fabric.

Pertaining to Apparel

COMBINED SKIRT AND SPORTING TROUSERS.—N. J. TJAERANSEN, Konsul Jensens, Gate 906, Christiansund, Norway. The invention is particularly distinguished by the arrangement of two different rows of buttons in order to obtain a good fit when the suit is to be used as trousers or when used as a skirt. Moreover there is arranged a quite short inner pair of drawers attached to the waist band providing a closure for the upper part of the garment.

HOSE SUPPORTER.—F. D. GRAVES, 70 Church St., Owego, N. Y. This invention relates particularly to a form of button carrying backing plate and a method of securing the tape of a hose supporter within the backing plate. A still further object is to provide a device which will be practical and durable in use, resulting in a saving of tape, and a supporter in which the tape may be readily threaded.

COLLAR FASTENER.—S. L. GEDNEY, 33 Clinton Ave., Maplewood, N. J. This inventor has been granted two patents of a similar nature, the first relating more particularly to a pin to be positioned through a soft collar to hold the outer flaps or wings in neat and proper position, the second providing a collar fastener in the form of clamps which can be readily attached to the flaps of the collar to prevent accidental movement either vertical or longitudinal; the clamp devices may be readily attached and fastened together by a snap ring in the center, or by a permanent bar.

HOSE SUPPORTER.—BELLE C. HARRISS, Pelham Rd. and Locust Ave., New Rochelle, N. Y. The object of this invention is to provide a hose support more especially designed for holding up women's hose without danger of tearing the hose, at the same time insuring a proper fit particularly across the knee. Another object is to hold the upper portion of the hose circumferentially to the wearer's leg, thus relieving the hose of strain yet enabling the wearer to freely exercise the limbs without tearing the hose. A further object is to hold the wearer's corset down to produce the desired straight front effect.

SHAWL COAT.—L. KATZMAN, 325 5th Ave., New York, N. Y. The prime object is to provide a neat and stylish appearing as well as comfortable garment in the nature of a coat so fashioned as to be made from a single rectangular piece of material and with practically no waste parts. Another object is to provide means whereby two coats may be fashioned from a single piece of material such as a shawl, blanket or steamer rug.

Electrical Devices

FUSE PLUG.—J. WULF, 1127 Nostrand Ave., Brooklyn, N. Y. An object of the invention is to provide a simple and durable fuse plug for use with electric circuits, which comprises a body having spaced terminals and a fuse connecting the terminals, the body providing a receptacle for a spare fuse, which is normally separated from the live fuse. A further object is to provide a fuse plug in which soldered connections are avoided and in which the fuse is visible at all times.

BURGLAR AND FIRE ALARM.—LE ROY S. FOLTZ, Fort Collins, Colo. Among the objects of the invention is to provide a burglar and fire alarm which is in the nature of an attachment to the ordinary telephone system, being so arranged as to apprise the central office or a neighbor's house of the presence of an intruder without the knowledge of the intruder or the presence of a fire. The device includes an automatically operating receiver hook elevator with a contact making device for sending the signals over the telephone line.

ELECTRIC FUSE.—R. J. KINGSLEY, 2582 Parkside Drive, Baltimore, Md. The primary object of the invention is to provide a plurality of auxiliary fusible elements which may be conveniently brought into use either selectively or collectively to take the place of a destroyed fusible element. A further object is to so arrange the auxiliary fusible elements that they may be connected in parallel with the normally active fusible elements and thus accommodate a current of high amperage.

Of Interest to Farmers

GRAIN SHEAF SHOCKER.—J. P. HIEBERT, Box 741, Hillsboro, Kan. The foremost object of this invention is to provide a comparatively simple sheaf-shocking mechanism to be used in conjunction with any ordinary reaper, all of the functions of the mechanism being automatically performed, with the exception of the final shock-discharging operation, which is manually performed. Another object is to provide a shock-forming mechanism in which the various operations of handling the sheaves in the course of forming a shock are automatically controlled and accomplished by the individual sheaves themselves.

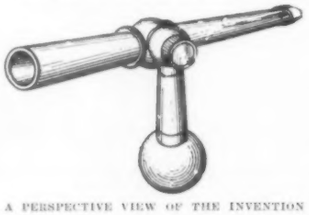
MOWER GUARD.—J. R. EDGAR, Ava, Ill. The object of the invention is to provide a construction of guard finger having integral upper and lower portions secured to opposite sides of the mower bar and exerting pressure or tension upon the cutter bar and cutters to insure a perfect engagement between the cutter blades and the stationary blades or shear plates of the fingers. A further object is to provide a construction of guard finger which can be used on any ordinary mower bar.

OBSTETRICAL TABLE. — P. C. JUHL, R.F.D., Princes Bay, S. I., N. Y. The object of the invention is to provide an obstetrical table especially designed to support a cow, horse, or other animal in propor position on its side to enable a veterinary surgeon or other person to conveniently operate on such animal, particularly in case the fetus is in abnormal position, and to prevent the animal from pressing against the operator.

BACKBAND.—J. B. MCHUGH, P. O. Box 16, Zachary, La. Among the objects of the invention is to provide a backband for draft animals which will be comfortable to wear and which will be readily adjustable to animals of different sizes. A further object is to provide means for securing the trace chains to the backband and to provide a backband which will be strong and durable.

Of General Interest

HOLDER FOR CIGARS AND CIGARETTES.—P. F. PINEDA, Barquisimeto, Estado Lara, Venezuela. The invention relates to a sanitary holder, the general object being to avoid the bad effects of the nicotine on the smoker; this object is attained by providing a holder in the



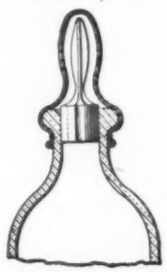
A PERSPECTIVE VIEW OF THE INVENTION

form of a stem comprising a mouthpiece and a receiver for the cigar or cigarette, together with means between the receiver and the mouthpiece a water container or smoke washer through which the smoke is caused to pass for eliminating the nicotine and cooling the smoke.

IDENTIFICATION DEVICE.—H. J. W. MORGENTHALER, address G. Burchard Smith, 55 Liberty St., New York, N. Y. The invention relates more particularly to devices for identifying babies in hospitals and the like. A further object is to provide an identification device which can be readily assembled to indicate the name of the child, and which can be quickly and easily positioned around the neck or arm of the child and sealed so as to prevent possibility of mistake.

COMPOSITION FOR WALL BOARD.—E. D. MARTINET, 5922 Towne Ave., Los Angeles, Cal. The invention has for its object to provide a composition especially adapted for use in the preparation of composition board. The composition is composed of ordinary building plaster, saw dust, extract of cactus juice and heavy black molasses. This composition forms a board which is sufficiently rigid, yet flexible and elastic, and will permit a nail to be driven through the same and will hold the nail so that it does not pull out easily.

ATTACHMENT FOR NURSING BOTTLES.—A. GERSTNER, 10428 90th Ave., Richmond Hill, L. I., N. Y. This invention comprises a novel device for use in connection with nursing bottles; it is made of semi-vulcanized rubber to be inserted within the nipple,



A SECTION OF BOTTLE WITH ATTACHMENT APPLIED

the plug member having rooves in its sides to limit the flow of liquid, the head member having wings to prevent collapsing of the nipple; this device being removable it can easily be cleaned which is the main point, making it sanitary.

ATTACHMENT FOR PENCILS OR THE LIKE.—A. A. BECK, c/o Lake Julian Sanitorium, Puposky, Minn. One of the principal objects of the invention is to provide an attachment for attaching an eraser to a pencil which permits not only of the feeding of the eraser as desired, but also allows the insertion of a new eraser when the original one is worn out, and which also functions as a clip for retaining a pencil in the pocket of the user.

BEDCLOTHES HOLDER.—E. T. EDLUND, c/o A. Erickson, 159 Christie St., New York, N. Y. The invention relates more particularly to children's beds, to prevent the clothing being accidentally displaced. The general object is to provide a device to be disposed across the bed at the foot providing means for engaging the bed clothes at their lower edges, and means by which they may be quickly clamped or unclamped in connection with the mattress.

STERILIZED ATTACHMENT.—P. P. PUPILLA, Bradley Beach, N. J. The invention relates to a shaving brush sterilizer which may readily form an attachment to a conventional sterilizer utilized in modern barber shops, and which shall be so extremely simple as to present virtually no outlay of capital in addition to the purchasing of the conventional sterilizer, and by means of which a brush may be rapidly sterilized, so that practically no loss of time is experienced in operating the same.

ANCHOR.—E. GOODREAU, Box 963, Cordova, Territory of Alaska. This invention has for its object to provide an anchor having a stem and flukes pivoted thereto and arranged to

A SIDE VIEW CLOSED, WITH PARTS IN SECTION

fold in substantial parallelism with the stem, or in positions radial thereto, and having means for locking the flukes in expanded position; the arrangement is such that the flukes open of their own weight. The anchor is especially designed for use on motor boats.

Hardware and Tools

GUN CLEANER.—A. C. DRUMMOND, 86 Prospect Ave., Ilion, N. Y. The object of the invention is to provide a cleaning tool for cleaning the barrels of shotguns, rifles, or revolvers, and which is provided with an arrangement of spiral cleaning blades which are capable of adjustment to correspond to the bore of the barrel to be cleaned.

KNIFE.—E. BOE, c/o H. B. Tempering Process Co., Clearbrook, Minn. The invention has particular reference to pocket or so-called pen knives in which the cutting blade or blades are adapted to assume an open or closed position relative to the handle in which they are mounted. The primary object is to do away with the customary spring and provide means for locking the blade or blades in either an open or closed position.

NUT LOCK.—C. R. COCHRAN, Box 373, Vale, Oregon. This invention has for its object to provide a lock which may be positively locked upon the bolt to prevent turning off of the lock, the lock having teeth at a predetermined point normally extending inwardly beyond the apex of the thread to positively engage the bolt, and adapted to be withdrawn beyond the apex of the thread by bending that portion of the lock to which the teeth are connected obliquely.

PIPE CUTTER.—M. J. CAFFREY, 319 W. 126th St., New York, N. Y. The object of the invention is to provide a pipe cutter arranged to permit of cutting a pipe without requiring the use of a vise or other separate means for holding or gripping the pipe while cutting the same. Another object is to permit accurate cutting of pipes of different diameters without requiring much physical exertion. The device is portable, simple, of few parts, and not liable to get easily out of order.

LOCK.—J. J. T. RODEN, 990 Jefferson Ave., Brooklyn, N. Y. The invention relates to certain improvements in connection with what is generally known as the "Segal lock" with a view to rendering the lock immune from breakage and disarrangement due to the door to which it is applied being slammed. A further object is to render an unauthorized opening of the lock practically impossible except by a duplicate key.

SWING HANGER.—A. J. NUSS, 706 Louisa St., Williamsport, Pa. An object of the invention is to provide a self-lubricating hanger which will overcome the annoyance of squeaking porch swings and similar devices. A further object is to provide a hanger and hanger mounting which is noiseless and at the same time strong and durable in use, and which will be cheap to manufacture.

Heating and Lighting

RETORT.—H. M. BARR, Box 1070, Pensacola, Fla. The object of the invention is to produce a retort in such form that the high degree of heat required to successfully operate and efficiently carry out the process of distillation may be attained without the employment of cumbersome and unyielding jackets of brickwork, concrete or other masonry, thereby eliminating the damaging effects due to ruptures or cracks that occur in the masonry.

GAS STOVE.—M. COHEN, 31 Union Sq., New York, N. Y. The general object of the invention is to provide a gas stove designed for use as a cook stove and more particularly with a view to increasing the usefulness of the stove in such culinary work as is generally included in baking, broiling, frying and the heating of water.

GAS HEATER.—H. B. DALLIMORE, 218 Logan St., Brooklyn, N. Y. This invention relates more particularly to a gas heater adapted to be quickly and easily positioned in the fire box of an ordinary coal range, an object being to provide a heater of the character stated which will function as a heater for the water back as well as the oven and stove top to permit the use of the range for all ordinary purposes dispensing with the necessity for using coal.

Machines and Mechanical Devices

ADJUSTABLE BUSHING.—H. M. CLOSE and H. G. TAYLOR, 21 S. Jefferson St., Webb City, Mo. The object of the invention is to provide a bushing especially adapted for use with hoisters, and which is capable of adjustment from the inside of the drum. The bushing is split in halves, that is to say, is sec-

(*Continued on page 418*)

Putting Waste Metals to Work

(*Continued from page 415*)

first method the tin is reclaimed in the form of a spongy granulated precipitate, which can be remelted into pig tin; by the second, tetrachloride of tin is recovered for use in the weighting and the dyeing of silk; and by the third procedure the tin is secured as an oxide, which is employed as a coloring agent in the enamel industry or melted into pig tin by means of a reverberatory furnace.

Aluminum chips from castings produced in the making of automobiles have become a large source of secondary aluminum. By the old treatment the loss in remelting such chips was sometimes as high as 40 per cent, but government experiments revealed awhile back that it was quite practicable to lower this loss to as little as 10 per cent. The secondary aluminum, in the shape of pig aluminum or in alloys, totaled a matter of 18,691 short tons in 1919, and was valued at $12,014,600. Various products are made by smelters and refiners from scrap aluminum. During the same year we obtained 2,447 short tons of secondary nickel worth $1,829,400. Of the resultant refined nickel, about 60 per cent is used in nickel steel, 30 per cent in white-metal alloys, 5 per cent in anodes for plating, and 5 per cent for miscellaneous purposes, including the manufacture of salts and other chemical compounds. As has been well said, "By depriving the market of any useful scrap metal the price of virgin metal is driven up proportionately."

Finally, in sketching the potential savings through the recovery of secondary metals, let it be said that blast-furnace flue dust, which is so often neglected, has an iron content of more than 40 per cent. By briqueting this dust it can be fed back to the furnace and much of the valuable iron in it can be melted and cast into marketable pigs. The recent perfecting of machinery for briqueting this material opens up channels to tremendous economies. Our large industrial enterprises are profiting by the lessons learned during the late conflict, but the thing needful is to impress upon their smaller brethren that they, too, ought to adopt the same practices so that the nation as a whole may be the better fitted to cope with the foreign producer.

The Truth About the Dye Industry

(*Continued from page 408*)

for the production of essential pharmaceuticals. Some of the most necessary drugs for the maintenance of public health are produced from coal-tar products. I will mention only such things as salvarsan, aspirin, novocain and phenacetin.

Prior to 1914 we were entirely dependent upon Germany for these products; today, physicians and dentists will tell you that they are difficult to obtain, and are very expensive. They have not yet been produced adequately by the American dyestuff manufacturer, but given a fair field this is the next step of development which, already in preparation, is bound to come. Is it not advisable that an industry which can yield such substances for the relief and benefit of the human race should be maintained?

Again, we are reaching a point where in many sections of our country, the soil has become exhausted and requires replenishment with those necessary chemical ingredients which enable it to yield its full percentage of crops. These chemicals again come from the collateral chemical lines intimately connected with the coal-tar chemical industry, such as the products of nitrogen from the air, which make possible the necessary nitrates and the manufacture of ammonia, as well as other chemical factors which are indispensable to the proper preservation of land values.

Finally, the preservation of the coal-tar chemical industry is indissolubly associated with the national welfare, in that it is from this industry that the high explosives and poison gases are obtained which have made modern warfare what we realized it to be in 1917-1918.

The country which has a well-established coal-tar chemical industry, is the country which is ready to meet an aggressive attack almost at a moment's notice. The same plants which produce coal-tar colors can be changed and diverted into the manufacture of poison gases and high explosives with the least possible margin of delay—to use a slight literary exaggeration, almost over-night.

For instance, there is a black dye, sulfur black, very extensively used for dyeing our black cotton stockings. In its finished state, it is simply a harmless, grayish-black powder. If the process of its manufacture however had been stopped before the last step was completed, and had been switched off in another direction, we should have produced picric acid, one of the most powerful explosives known.

Again, a certain brilliant yellow dye, made from coal tar, and in universal use for obtaining delicate golden tints, if also stopped before the completion of the final step, produces one of the most deadly forms of poison gas, a gas which renders modern rifle fire and the machine gun ineffective and useless to the same degree as the high-powered bullet threw into the discard the shoulder-to-shoulder formations and solid squares of the days of Waterloo.

There is a story, which may be apocryphal, that prior to 1914 one of the largest German dyestuff manufacturers was making, under instructions from Berlin, large quantities of di-nitrotoluol. There was no particular market for this product, and they simply continued its manufacture, piling up huge quantities without any apparent outlet for it. When the war broke suddenly upon the world in 1914, instruction came from Berlin to add one part of nitric acid to this di-nitrotoluol and it was immediately converted into tri-nitrotoluol—TNT.

With this TNT Germany battered down the walls of Liege and Antwerp and blasted her way through Belgium and northern France, while the Allies were still under the delusion that they could hold back her gray hordes by peppering them with shrapnel.

Some weeks ago a squadron of airplanes flew over the lower part of New York. They were a beautiful sight, and the surging crowds filling the streets at the noon hour watched them with admiration and interest. In their passage over the business district, they dropped smoke bombs and marked the places where they struck. The layman cannot easily imagine what would have happened if these had been bombs filled with TNT and poison gas; but the expert knows. Theoretically, these planes destroyed the whole lower part of New York and its dense day-time population in fifteen minutes. And this destruction would have been caused by products obtained from the coal-tar chemical industry.

Do we want to see this country placed in a position where such a thing as this might easily happen; where from the decks of a line of mother ships anchored twenty miles off shore, such a squadron might have been sent to cause this destruction without any possibility of defense? The world is sick of war, but is there anyone who is so optimistic as to believe that war has been finally abolished? As long as human ambition leads individuals to seek the glory that comes from triumphant war, as long as the surging yellow and brown hordes of overpopulated countries are seeking outlets for their millions who are starving to death on their own resources; as long as the industry and commerce of a nation develop beyond the point where its products can be absorbed by the home mar-

(*Continued on page 419*)

RECENTLY PATENTED INVENTIONS

(Continued from page 416)

tional so that it may be applied or removed without taking the drum from the shaft. A door is provided giving access to the interior of the drum.

GREASE CUP.—D. E. HARDMAN, Simms, Mont. A purpose of this invention is to provide a grease cup in which there are no screw-threaded portions to be removed when refilling

A VIEW IN ELEVATION AND THE CAP

the cup, thereby eliminating the remeshing of the threads when closing the cup. A further purpose is to provide a cup which is quickly and easily removed, and means for automatically locking the same against accidental displacement.

MERCERIZING MACHINE.—J. SPITZER, 425 Hill St., W. Hoboken, N. J. This invention relates to apparatus for mercerizing cotton yarn by the use of caustic soda or similar mercerizing solutions. The object is to provide a machine arranged to effectively and economically mercerize a large amount of yarn at each operation, and in a comparatively short time, the machine being continuous and automatic in operation and not requiring the services of highly skilled labor.

BUFFING OR POLISHING WHEEL.—A. LEVETT, 125 W. 12th St., New York, N. Y. The object of the invention is to provide a polishing device arranged to combine with the body of the wheel a polishing compound without requiring the workman to periodically apply the compound to the peripheral face of the wheel. Another object is to leave the work exceedingly bright and clean without any particles of the polishing compound adhering to the crevices, filigree or other ornamentations on the article being polished.

SHUTTLE MOVER.—F. J. BAUME, 42 Primer Place, Avenida, Wruguay, Mexico City, Mex. This invention aims to do away with the usual means actually in engagement with the shuttle for moving the same and to bring about advantages not only in construction of looms but in construction of shuttles, by the application of shuttle moving means which will effect the desired results as far as movement is concerned without actually engaging the shuttle.

PAPER FEEDING APPARATUS FOR TYPEWRITERS.—W. C. AVERY, 2320 Vancouver Highway, Honolulu, Territory of Hawaii. It is a purpose of the invention to provide a paper feeding apparatus and mechanism including trays for supporting the paper, such trays being balanced to coact with feed rollers to effect a simultaneous feeding of a plurality of sheets of paper in such manner that the sheets will occupy corresponding positions on the platen of a typewriter.

PERFORATING AND CUTTING DEVICE FOR MULTIGRAPHS.—W. T. COLLINS, decd. W. DeMilly, Box 445, Tallahassee, Fla. The invention relates to a device which is in the form of an attachment so that it may be applied to a multigraph machine of ordinary construction for perforating and cutting the paper as it leaves the machine. It is a purpose to provide an attachment in which the cutting and perforating blades are associated with supporting disks to permit of the removal and substitution of other disks when they become worn or broken.

SECTIONAL CABLE FOR HANDLING LOGS.—W. H. PETERS, 1378 Tabor Court, Portland, Ore. This invention relates to devices for use in logging and has for its object the provision of a cable formed in sections which are flexibly connected by clevises to which may be secured chains connected with logs whereby the logs may be properly handled at all times and especially while they are descending an incline.

Musical Devices

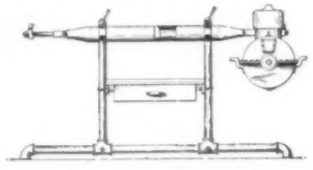
CONTROLLING DEVICE FOR PHONOGRAPHS.—E. O. BREUNING, 58 8th St., Hoboken, N. J. The principal object of this invention is to provide a device in the nature of an attachment for phonographs which is designed to actuate the phonograph at a predetermined time. Another object is to provide time-controlled mechanism for actuating the turn table of a phonograph prior to the presentation of the needle in contact with the record; the device will also automatically stop the phonograph. A further object is to provide a controlling mechanism which is applicable to clocks of various standard types.

TONE FOOT FOR PHONOGRAPHS.—W. H. PRICKETT, 46 Yard Ave., Trenton, N. J., P. O. Box, 299. The invention relates to feet for use beneath the legs of phonographs and has for its general object to provide a foot, the use of which will result in a clearer and more distinctive reproduction of the record, with a smooth and full tone and in a manner to preserve the characteristics and beauty of the original production.

DISK RECORD.—H. W. MEYER, 5412 Greenwood Ave., Chicago, Ill. This invention relates to disk records for phonographs. An object is to eliminate the trouble so often experienced in locating the beginning of the record groove, by providing a locating or guide groove which is of such size that it can be readily seen and in which the needles will automatically find its way to the record grooves.

Prime Movers and Their Accessories

STAND FOR FORD ENGINES.—C. C. PRICE and D. V. BRIDWELL, Dumas, Ark. A purpose of the invention is to provide a simple and compact stand which is designed to support two engines of the Ford type in such manner

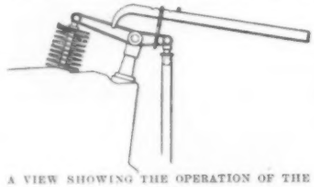


A SIDE ELEVATION OF THE DEVICE WITH ONE ENGINE IN POSITION

that the overhauling and disassembling of one engine can be carried on without interfering with the disassembling of the other. A further purpose is to provide a stand which is adjustable to varying positions so as to render any part of either engine accessible.

ENGINE PISTON.—J. W. CALTA, Platte, S. D. The invention relates to pistons and cylinders of internal combustion engines. An object is to provide a piston having means for preventing the working of the oil up into the explosion chamber, said means comprising a plurality of recesses forming pockets which may contain a sealing compound.

PUSH ROD EXTRACTOR.—R. F. BAILEY and R. T. HOOPINGARNER, address S. N. Edgman, Box 71, Holly, Colo. Among the objects of the invention is to provide tools for com-



A VIEW SHOWING THE OPERATION OF THE DEVICE

pressing the valve operating spring on internal combustion engines and particularly on that type of internal combustion engine employing valves of the overhead or valve-in-head type, to facilitate the removal of the push rod therefrom.

INTERNAL COMBUSTION ENGINE.—N. T. COLLINS, 707 8th St., Sacramento, Cal. An object of this invention is to provide means for holding the compression of the gas mixture in the combustion chamber at the desired pressure while the engine passes over top center. A further object is to provide an auxiliary cylinder and piston, said cylinder communicating with the main cylinder of the engine and the piston of the auxiliary cylinder controlled by the crank shaft through the medium of operating means so as to hold the compression for efficient results.

CARBON REMOVER.—R. R. CHAMPLIN, R.F.D. No. 1, Manchester, N. H. The invention relates to a composition for removing carbon from internal combustion engines, and which in operation will not injure any part of the engine or mechanism with which it comes in contact, and a further object is to provide a composition which may be cheaply made comprising denatured alcohol, benzine, kerosene, water, camphor, sodium hydroxid and sodium carbonate.

HEATING APPARATUS FOR INTERNAL COMBUSTION MOTORS.—H. J. BERRUET, 22B Rue Vallier, Lavallois-Perret, Seine, France. In internal combustion motors using heavy oils which are not volatile at ordinary temperatures, it is necessary to employ a suitable apparatus for the purpose of effecting a complete vaporization of such liquids before admitting them to the cylinder. The present invention has for its object to provide a supplementary arrangement for heating by means of a branch off the exhaust. The invention also automatically regulates the amount of exhaust gas employed for effecting the supplementary heating by means of controlling the admission of the gas into the cylinder.

Railways and Their Accessories

DRAFT APPLIANCE FOR LOCOMOTIVES.—G. J. HUESTIS, c/o Canadian Customs, Belleville, Ontario, Canada. The principal object is to provide means for controlling the discharge of steam from the exhaust nozzle in the smoke box by the provision of an attachment for the exhaust nozzle which will permit the steam to be deflected through opposite sides of the center or adow the draft to go straight up through the stack in accordance with the desire of the engineer.

Pertaining to Recreation

GAME.—N. D. DILLON, 621 1st Ave. West, Seattle, Wash. The invention relates to a card game. While it is primarily intended for the amusement of the participants at the same time it serves as what is commonly known as a psychological test, in that it brings to the surface all of the perception and reaction and causes the player to make quick decisions.

WHIRLING TOP.—J. T. EDSON, Sailors Snug Harbor, New Brighton, S. I., N. Y. The particular object of the invention is to provide a toy involving the use of weighted cords adapted to be caused to whirl simultaneously in substantially the same plane but in opposite directions, having the characteristic of exciting the interest of any observer who may not be familiar with the physical principals involved and so rendering the toy of an attractive nature.

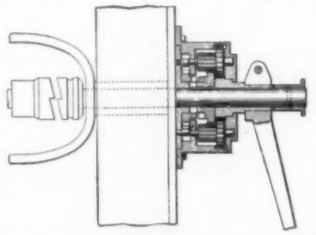
GAME.—V. DICKERSON, c/o G. C. Cowley, Station T, New York, N. Y. The invention relates to that class of device in which pellets of desired construction are utilized in connection with what might be termed a maze, a central inclosure being associated with such maze into which the pellets are to be guided by tilting the supporting means for the maze, but without the assistance of the hands in direct contact with the pellets.

Pertaining to Vehicles

LOCKING DEVICE.—D. E. WERTS, 137 Farragut Ave., Olympia, Wash. An object of the invention is to provide a simple, rugged, effective and easily attachable device, capable of attachment to certain parts of an automobile, particularly to the segment on the steering wheel with which the gas and spark levers are connected, and one which when once locked on the machine cannot be taken apart or tampered with except by the person having the proper key.

ALINEMENT DEVICE FOR AUTOMOBILES.—C. S. PEETS, 250 W. 54th St., New York, N. Y. The invention relates to automobiles of the Ford type, and its object is to provide an alinement device arranged to reduce sidewise swaying of the car body to a minimum. Another object is to readily permit of applying the device without requiring changes in the construction thereof.

STARTING CRANK FOR MOTORS.—F. F. REDDING, 8932 89th St., Woodhaven, L. I., N. Y. The primary object of the invention is to provide a starting mechanism of the hand-cranking type for internal combustion engines commonly employed in motor vehicles, and more particularly to engines used in trucks.



A HORIZONTAL SECTIONAL VIEW WITH A PORTION SHOWN IN PLAN

It is a further object to provide means for preventing a movement of the starting crank in the reverse direction, which sometimes occurs owing to a premature expansion in the motor cylinders.

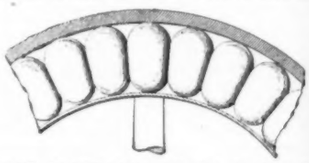
GARAGE STRUCTURE.—G. A. SHAUL, Seneca, Kan. The purpose of the invention is to provide structure of simple and fireproof construction, and which will form a plurality of garages for the individual housing of auto-

A TRANSVERSE SECTIONAL VIEW, SHOWING DRIVEWAY AND GARAGES

mobiles. A further object is to provide a garage having a common driveway and a roof disposed above the roof of the individual lockers or garages, the walls connecting the roof of the driveway with the roof of the lockers being formed with windows to allow the transmission of sunlight and air.

AUTOMOBILE SIGNAL.—E. HEBBELN, 1628 W. 16th St., Davenport, Iowa. This invention has reference to automobile signals designed to replace the custom of extending one's arm and hand from the side of a car to indicate when a turn is to be made, and thus avoiding collisions and accidents. The device relates to a signal visible in day or night, and especially adapted for foggy weather, being discernible at a considerable distance. The signal is conveniently operated from the driver's seat.

RESILIENT TUBELESS TIRE.—A. H. YOUNG, 1123 12th Ave., Oakland, Cal. The particular object of the invention is to provide a tire construction which will avoid the usual disadvantages with respect to blow-outs,



PARTIAL LONGITUDINAL SECTION OF THE TIRE

punctures and the like requiring replacement and repair of an inner tube when it is once perforated. The invention also has for its object the provision of a non-deflatable tire adapted alike to wheels of different vehicles employing pneumatic tires at the present time.

REAR AXLE DRIVE FOR MOTOR VEHICLES.—O. S. PULLIAM, Room 2528, Park Row Bldg., New York, N. Y. The primary object of this invention is to provide a device which is adapted to take the place of the ordinary differential commonly employed. A further object is to provide means by which differential movement of the driving wheels of a motor vehicle is obtained, at the same time provision is made for positively locking both the wheels with the power transmitting element.

SELF-PROPELLING CRANE.—G. BRUN, 1 Rue Jules Lafebvre, Paris, France. This invention has for its object to provide a self-propelling traveling crane so constructed that the motor that propells the vehicle shall likewise be capable of being utilized for operating the crane, that is to say, to slue the crane around on its own axis and to wind up the lifting rope.

BICYCLE.—O. J. HENNEBAUL, 223 E. 122nd St., New York, N. Y. This invention relates to a bicycle which is especially adapted for use by boys, and has for its object to provide a bicycle of simple and inexpensive construction so that said bicycle may be produced at a minimum cost. The steering head, braces, handle bars, wheels and saddle all being made of wood; the balance of metal to give added strength.

Designs

DESIGN FOR A SPOON-KNIFE.—I. RUPP, Gaston, Ore.

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The Truth About the Dye Industry

(*Continued from page 417*)

kets, and where foreign outlets must be sought, there will be the possibility of war. The next war will be a chemical war, and the nation which has safeguarded its chemical industry and has enabled it to become self-sustaining and independent of foreign contributions will be the nation which, because it is prepared, will be the most free from foreign aggression.

The new hope of mankind is embodied in the word "disarmament." Armies are to be reduced to a minimum; the building of forty million dollar battleships is to be abandoned; obsolete war vessels are to be scrapped, and war planes, capable only of being used for offensive purposes, are to be no longer built—but no nation can afford to disarm and to make itself defenseless against attack, unless it has an industry from which, with the least possible loss of time, indispensable trained chemists may be obtained, and products which are the basis of munitions of war secured for its defense.

That is what the coal-tar chemical industry means to us. When we hear that our Congress has been asked to pass that legislation which will enable it to protect itself for a few years longer against threatened foreign competition, even now being prepared by a nation which is determined to regain its military and industrial control of the world, and based on cheap labor costs and depreciated currencies, it is to be hoped that each one of us will lend his individual influence wherever it may be applied, to seeing that this protection is afforded, not for the purpose of building up a money-making monopoly, or even for giving one branch of industry especial consideration, but that we may be maintained in the guaranteed security of our own interests and in the peaceful possession of our own homes.

The Giant of the Skies

(*Continued from page 409*)

bly never can be put to a precise and thorough test, and which in addition to the doubt thus thrown upon their results, admittedly are a matter of probabilities only, so that in the cases of individual stars they may give us results that are far from the truth. In spite of these drawbacks, there are ways of checking up in a general way the determinations of distance thus obtained; so the astronomer feels safe in stating that Betelguese is more than 250 and less than 300 light years from our own system.

A light-year is of course the distance traveled by light in a year. If we feel that we must have it in terms of a more familiar unit, we can convert the light-year into miles by the simple process of multiplying together the numbers 186,000 (miles per second for the velocity of light), 60 (seconds in a minute), another 60 (minutes in an hour), 24 (hours in a day), and 365 (days in a year). If we do this and express the result in the round numbers which alone possess significance in dealing with such magnitudes as these, we find the light-year to be the equivalent of some 5,800,000,000,000 miles—or better yet, six trillion miles. Betelguese, then, in spite of his prodigious size, is so far away from us—close on the number of miles measured by a 2, followed by 15 ciphers—that he still appears to us, not alone with the naked eye but equally in the most powerful telescope, to be but a geometric point of light, without any magnitude. We should like to drag this distance of 300 light-years into our graphic comparison in some way; but we don't know how it is to be done. With the trivial expanse of 300 million miles we feel that we have had some success in seeking a pictorial representation; when it comes to two quadrillion miles—well, there isn't much hope. We really believe the most adequate way to convey an idea of this is to state the velocity of light in miles per second, with the number of years it takes it to reach us from Betelguese at this speed.

Then, lest the reader should get the feeling that this must be about the limit, and that he has surely plumbed the depths of space, we may throw in gratuitously the remark that the distance of 200,000 light-years is stated with reasonable accuracy in connection with the most remote *visible objects* whose distance has as yet yielded to analysis; and that Dr. Einstein finds this figure far too small for his finite unbounded universe, putting the extent of this at some 200,000,000 light years—no, not miles or astronomical units of 93 million miles each, but *light-years*. After this we shall presumably be convinced that the juggling of long strings of zeros neatly done up by means of commas into packages of three has gone about far enough. The difference between an infinite universe on the old Euclidean plan, and a pseudo-Euclidean framework of a mere 1,000,000,000,000,000,000,000 miles, is not large enough to cause any of us to pass sleepless nights. In the event that our enthusiasm for large mouthfuls of digits is not yet satiated, however, we might set to work estimating how many electrons, of some .000,000,000,000,000,000,025 *inch* diameter each, could be accommodated, at a pinch, in this finite universe. It's a small matter, but just as a formality we remind the person who undertakes this not to overlook the fact that there are 63,360 inches to a mile.

Einstein's Theories of Relativity and Gravitation

(*Continued from page 409*)

Mr. Bolton's rather unadorned statement of the postulates and the consequences is admirably supplemented by the essay from Mr. Francis, of New York, which frankly devotes practically all its space to a discussion going to show by means of brilliant analogies just why and how the concepts of space and time have to be modified, and how this modification can lead to a new theory of gravitation. Commander McHardy, of London, contributes an essay of somewhat similar scope, but written with less attention to analogy and more to technical detail regarding the nature of the world under the new concepts. Mr. Hugh Elliot, of Chiselhurst, Kent, is selected as the essayist who, to quote the preface, "has come closest to really explaining relativity in terms familiar to everybody, without asking the reader to enlarge his vocabulary and with a minimum demand so far as enlarging his mental outlook is concerned." Dr. de Sitter, the eminent Dutch astronomer, contributes an essay which is of value in showing how the General Theory may be made to stand on its own feet, and developed independently of the Special Theory—something which we believe many lay readers had not previously realized. Dr. E. T. Bell of the University of Seattle takes as his text the idea, which we first saw clearly expressed by Eddington, that Einstein's contribution to science consists in having isolated, to a greater degree than ever before achieved, the contributions of the observer and of the observed external; the external reality is shown to be far more tenious than we should have supposed. Dr. Dushman, of the Schenectady laboratories, and Mr. Hemens, of London, develop in somewhat different fashion another central idea of the Einstein theories—that the gravitational effect is due, not to a "force" of some mysterious sort, but to the observer's interpretation of an inherent geometrical property of time and space. Mr. Davis, of the University of Wisconsin, again quoting the book (this time the chapter subhead), gives us a treatment in which the essentially mathematical characteristics of Einstein's work "are brought out more strongly and more successfully than is usual in a popular explanation." Dr. Murnaghan, of Johns Hopkins, looks upon Einstein's structure

as the logical climax of modern physics, which for a long time has been engaged in what his title announces as "The Quest of the Absolute." Dr. Pickering of Harvard and Jamaica, tells us exactly what the new theories mean to the physicist and the astronomer. Dr. Russell, well known to SCIENTIFIC AMERICAN readers, has stated conversationally that he disagrees with those scientists who regard the General Theory as the most significant of Einstein's two productions; and he justifies his belief by contributing what every reader, lay or technical, must believe is correctly characterized by the Editor as the best discussion of the Special Theory found in any of the competing essays. Considerable parts of the essays of Dr. T. Royds, of the Kodaikanal Observatory in India, Prof. W. F. G. Swann, of the University of Minnesota, and Prof. E. N. da C. Andrade, of the British Ordnance College, furnish material of value not found elsewhere. The volume is concluded by a few fragments on the General Theory that have seemed too good to lose—the corresponding material on other phases of the subject has been worked into the introductory chapters.

We do not regard it as a confession of weakness when anyone admits that some of the chapters of this volume are unintelligible to him. But that the care which has been taken to pave the way properly has made it possible for anybody to get out of this book a better understanding of relativity than out of any other we believe is certain. Einstein himself pays far too much attention to the details of the process by which the theories developed in his mind—it may be advantageous to think them out that way in the first place, but every teacher knows that there is usually a better way to present a subject to the beginner than the way in which it was originally made a part of human knowledge. Eddington's book is admittedly far beyond the ordinary reader. Dr. Slosson we suspect would be the first to admit, if cross-examined, that he had fallen short of telling the reader the really significant things about his subject. Several books which we shall not mention by name we can most charitably characterize as thoroughly mediocre. We believe we have in this volume the only book which makes a reasonable combination of completeness and intelligibility—the only one that tells anything worth while about Einstein's theories while at the same time telling the story in understandable fashion. If we may not follow the footsteps of one of our enthusiastic editorial colleagues who regards the book as the last word on relativity, we feel surely entitled to refer to it as the latest and the best. If there is any virtue in numbers, it ought to be—65 authors surely ought to get most of the meat out of the subject.

Radio with the Arc Transmitter

(*Continued from page 410*)

kind of radio set and were picked up by a collector of customs and given a "temporary permit," are a thing of the past. With the increased efficiency which has been recognized for the past few months, it is thought that the number of arc installations will rapidly increase.

The Air Mail Service, which is under the jurisdiction of the Second Assistant Postmaster General, now maintains a series of six arc stations at landing fields in the West. Communication, night or day, is carried on directly between North Platte, Neb., and Elko, Nev., which are approximately a thousand miles apart. The territory intervening is of the worst possible nature for radio communication. Messages between these two stations are copied directly on typewriters by the operators, so the intensity of the signals may well be considered as very good. In this instance a few changes have been made in the apparatus, in order to make it most adaptable to the service to which it is put, while the amount of power consumed is 3 kilowatts. It is doubtful that there is any such efficient communication, where the same amount of power is consumed, any place in the world.

In addition to its carrying power, arc transmission has the advantage of what is called "sharp tuning," which makes it possible for more stations to operate at a given time without interfering with each other.

Several South American papers, including the Buenos Aires *Herald*, have commented at length on the work being done by the "Aeolus." It is a revelation to them and it is thought that their interest will be followed by the purchase of similar equipment from this country.

A majority of the apparatus formerly sold to South America for radio purposes was either English or German. Most of it was as good as could be procured at the time it was designed, but it is antiquated now and in deciding on replacing the old apparatus, as well as in the erection of new stations, much attention is expected to center about the arc sets.

The arc transmitter is a producer of continuous waves and these waves are much more effective in overcoming difficulties which arise from static. For this reason, also, the arc will meet with favor in those countries where there is likely to be a prevailing atmospheric condition of that character.

A Super-Dreadnaught as Target

(*Continued from page 412*)

showing clean perforations of the 12-inch belt and barbette armor of the "Seydlitz," "Derfflinger," etc., and Commander von Hase, gunnery officer of the "Derfflinger" at Jutland, has admitted in his book, "The Two White Nations," that the two after turrets of his ship were totally wrecked in succession by direct penetrations from British 15-inch projectiles which exploded after passing through the barbette armor.

Interesting as these "Baden" experiments have doubtless been, they will be surpassed in educational value by the test which is to be made this summer with the British battleship "Agamemnon." This old ship, of a type intermediate between the pre-dreadnaught and the dreadnaught, is now being equipped as a movable target under wireless control, and will be attacked by the guns of the Atlantic Fleet. The speed and course of the target will be unknown to the firing ships, and as the practice is to be at considerable range the experiment should result in valuable evidence as to the present efficiency of the British Fleet at long distance firing.

A Rocky Mountain Town Which Runs Its Own Plant

(*Continued from page 413*)

There was also some dissatisfaction with the local company already in the field, which naturally opposed the project vigorously when it heard the citizens talking up the subject. In fact the corporation sought to enjoin the city from spending the city funds outside of the city limits when it became necessary to seek the source of power in the Rocky Mountains some 20 miles away, but this difficulty was overcome by the organization of The Longmont Service Company, a private corporation of 63 public-spirited citizens, who built the power plant, transmission line and substation and sold them to the City of Longmont at the original cost of $40,500, thereby extending their credit to their home town to that amount and taking in payment city warrants payable from 65 per cent of the net earnings of the plant.

A never-failing water supply had already been assured two years before by throwing a dam across the north fork of the St. Vrain River to form a settling basin, freeing the water of silt before it was piped for domestic use, and the city built its power plant on this pipe line. The pure mountain water, fed by the melting snows, is led overland in a 30-inch concrete pipe from the face of the dam for 4½ miles on a water grade to a point above the power house where it enters a 20-inch steel pressure line and drops 475 feet with force sufficient to generate 800 horsepower.

The consumers have the advantage of an unusually low rate, namely, two and three cents per kilowatt, based on the amount taken, from April to October and 10 cents during the winter months, November to March, each house being also allowed one porch light at night free. About 1,600 meters are connected to the system and 75 families use the electric current for cooking exclusively. A household's bill will run from $2.50 to $10.00 per month according to demand for the current.

On the bookkeeping side the city seems to be coming out ahead. The investment in power house, transmission line and so on represents $10,000, which in the nine years since the current was first turned on has been fully paid for, and the city's balance sheet shows a surplus of $150,000. The gross annual revenue is about $60,000. It did not seem fair to the Water Department to ask it to stand the entire expense of impounding the water in the first place and the Electrical Department get the use of it for nothing, so it was arranged for the Electrical Department to pay an annual rental of $12,000 to the Water Department.

When Oil Barrels Become Silos

(*Continued from page 413*)

tainers were opened on November 20. With the exception of Russian thistle, contained in one of the principal silage mixtures, the stored product was in prime condition.

When using motor-oil barrels as substitutes for regulation silos, the investigators conducting the tests in South Dakota specify that utmost caution must be exercised in tamping the forage into the makeshift containers.

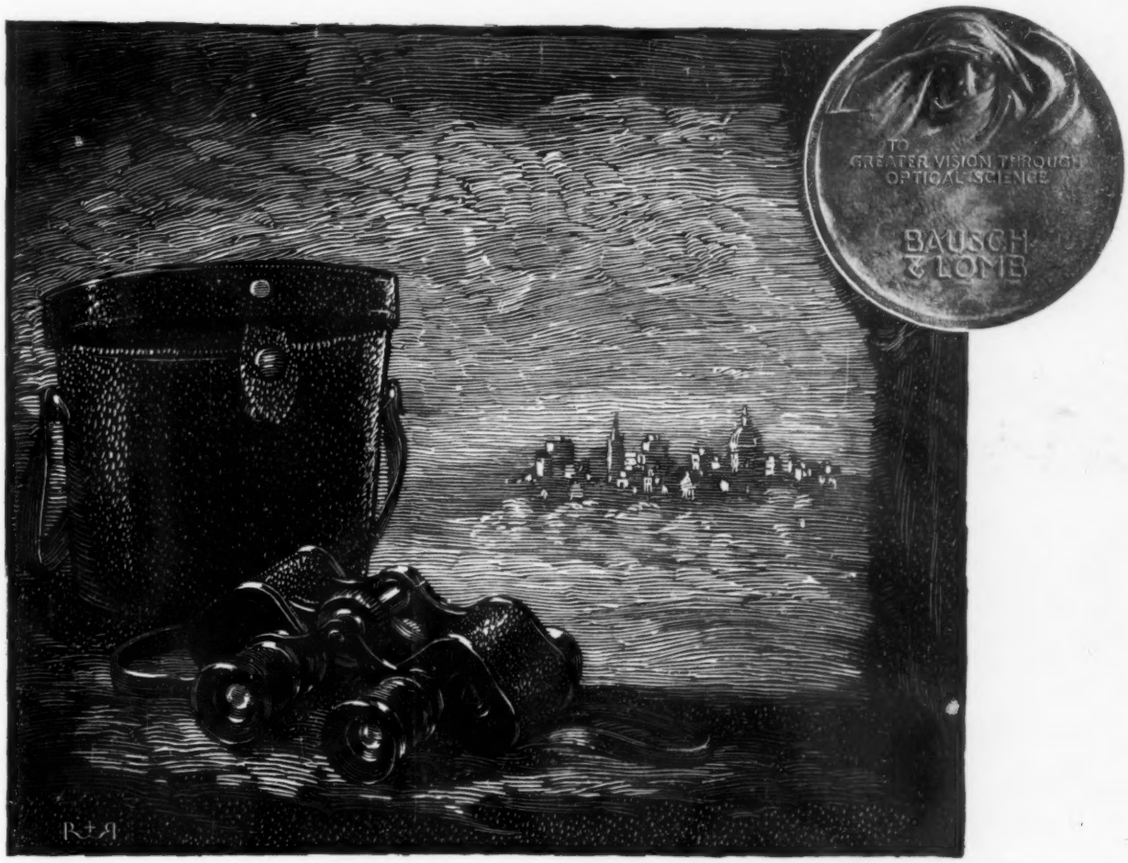
Alfalfa, sweet clover, sudan grass, corn sorghum, soy beans, Russian thistle, and wild sunflower were among the crops included in the major combinations already previously referred to in this article. The Russian weed alone evidenced a black and watery condition when taken from the containers, cattle refusing the uninviting product. Palatability experiments were conducted with the ensilage observations.

The South Dakota experiments, both chemical and biological in their search, will continue this year on a more comprehensive plan. Already the conclusions are such as to warrant the official statement that compactness is the predominating word in preserving the freshness of ensilage, whether the container is a standard silo or a makeshift, inexpensive motor-oil barrel. The continuous investigations, operating at a low figure, will be almost limitless in their scope of including plants whose identity as silage-substance has not heretofore been established.

The Electric Billy Goat and Its Work

(*Continued from page 413*)

butts the rear of the standard coal car. This action pushes the car up the long incline until it reaches the top over the hoppers, where it discharges its coal through gates on the bottom of the car. Tracks are on each side of the coaling house so that locomotives can get their coal from chutes which are on each side of the house. After the car is emptied, it is started down the incline and in this case pushes against the "billy goat." At the bottom of the run the "billy goat" is allowed to travel at full speed so that it can get away from the car which slows down when leaving the incline and going on the level track. The "billy goat" then goes out of sight between the rails and the car takes a flying switch on to a side track used only for empties.



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